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JANETOSPHAERA, A NEW GENUS, AND TWO NEW SPECIES OF VOLVOX

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FIVE PLATES AND FIVE TEXT FIGURES

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INTRODUCTION

There have been recognized, hitherto, four species of *Volvox* that have their cells connected by protoplasmic strands. Two of these, *V. globator* (L.) Ehrenberg and *V. aureus* Ehrenberg, have long been known, and have been the subjects of detailed study by several investigators, chiefly in Europe, with results which were summarized in the papers of Klein ('89A and '90) and of Janet ('12). The two others have been described more recently; *V. perglobator* Powers ('08) from North America and *V. rousseleti* West ('10 and '18) from Africa.

The two older species are readily distinguishable from one another by the form of the vegetative cells and by the character of the outer wall of the oospore. *Volvox aureus* has cells which are round in surface view and connected by protoplasmic filaments as slender as the cilia, and the outer wall of the oospore

is smooth; while the cells of *V. globator* are angular in surface view and connected by relatively stout protoplasmic processes, and the outer wall of the oospore is verrucose with conical warts (West, '10). A more fundamental difference between these species was demonstrated by Meyer ('96) in his investigation of the structure of the membranes of these organisms; a difference so great, in my estimation, as to warrant the separation of *V. aureus* from *Volvox,* which I now propose, under the name Janetosphaera genus novum, based on Meyer's text figs. 3 and 4 (reproduced herewith as text figs. 1 and 2) of the cell membranes as compared with his text figs. 1 and 2 (reproduced herewith as text figs. 3 and 4) of the corresponding structures of *V. globator.* For a clear recognition of the true status of *J. aurea* (Ehrenberg) Shaw it is desirable that membrane studies as detailed as those of Meyer be made to cover all phases of the life histories of these and other species of the larger Volvocaceae. Some specimens collected at Stanford University, California, in 1896, and still in my possession, will be described in this paper. They present the characters given by Klein ('89A) and by Overton ('89) for this species, and testify to its occurrence in western North America.

Of the newer species, *V. perglobator* (Powers '08) has vegetative cells very similar to those of *V. globator,* from which it is distinguishable by having a larger number of oospores, which often exceed 100 as compared with a range of from 12 to 40, and by having the outer wall of the oospore crenate. *Volvox rousseleti* (West '10 and '18) is readily separable from *V. globator* by the greater number of cells, 25,000 to 50,000; by the constant number of gonidia, 8; by the larger number of oospores, 120 to 150; and by the dense covering of spines on the spores. For *V. perglobator* no estimate of the number of cells is given by Powers, so we are left to assume that its range of variation in this respect is similar to that of *V. globator.*

In the vicinity of Manila, during the latter months of the rainy seasons of 1914 and 1915, I made collections which included several species of the higher Volvocaceae. Some of these have vegetative cells without protoplasmic connections, and display developmental characters which make it very questionable whether any of these organisms lacking the protoplasmic connecting strands between their cells should be regarded as species of the genus *Volvox.* They have been or are being described in other papers. Others, the subjects of this paper, do have protoplasmic connections between their cells.

For one of these which most nearly fits the description of *V. perglobator* (Powers, '08), but is readily distinguishable from it by having the outer wall of the oospore echinate, I propose the name Volvox merrilli, dedicating the species to Prof. Elmer Drew Merrill, who has been intimately associated with the locality in which this species was first collected, Pasay, on the southern outskirts of Manila, near Manila Bay.

The other new species has smaller, more or less pear-shaped vegetative cells and smaller oospores. For this the name Volvox barberi will be used, the species having been first collected by Dr. Marshall A. Barber, at Pasig, a few kilometers east of Manila. Collecting places which Doctor Barber reported at Pasig yielded three new genera of the Volvocaceae, four new species, and a total of at least six species in a great variety of life phases.

Descriptions of the two older species of *Volvox* (one under its new name), drawn only partly from material in hand, will now be given. These will be followed by transcripts of the descriptions of the species described by others that are considered by me to be properly retained in the genus *Volvox*, and then by descriptions of the new species.

Genus JANETOSPHAERA novum

(*Volvocaceae, Volvoceae*)

Type species, *Volvox aureus* Ehrenberg, fide Meyer.

Body a free-swimming hollow spheroidal coenobium of biciliate cells that contain chloroplasts. The cells appear to be in the periphery of a gelatinous matrix surrounded by a hyaline envelope. Protoplasts globose or ovoid in form, inclosed in thick membranes and partially separated by middle lamellae that extend as fibrils to near the center of the coenobium. Protoplasts connected by protoplasmic strands about as slender as the cilia. Asexual reproduction by gonidia that are differentiated late in the development of the soma or coenobium. Sexual reproduction by antheridia that produce spermatozoids, each of which has two cilia borne on the anterior end, and by oogonia that produce each a single egg.

The character of this species as summarized by Klein ('90, pp. 84 to 86) will be restated in the following paragraphs, and are, for the most part, probably drawn from one and the same species; though, as will be pointed out farther on, some were probably taken from very different species.

JANETOSPHAERA AUREA (Ehrenberg) comb. nov.

Volvox aureus Ehrenberg 1831 (fide Cohn).
Volvox globator Ehrenberg *ex parte* (fide Klein).
Volvox minor Stein 1854.
Volvox dioicus Cohn 1875.

Mature coenobia very variable in size according to habitat, and even in the same locality quite variable; 170 to 850 μ; coenobia of more than 500 μ forming only a small fraction of all.

Somatic cells average from 500 to 1,000, minimum about 200, maximum about 4,400.[1] Sexual coenobia mostly with more numerous cells than asexual coenobia of the same size.

Somatic protoplasts 5 to 8 or sometimes 9 μ in diameter, round, not crowded; chromatophores not extending into the connecting filaments; connecting filaments very slender, of about the same thickness as the cilia and sometimes in pairs or even threes between the same neighboring protoplasts.

Gonidia round like the somatic cells,[2] about 20 to 30 μ before the first division; connected with neighboring protoplasts by numerous protoplasmic filaments. Number of gonidia ranging according to habitat from 1 to 16, mostly 4 to 8 or 6 to 10. Bending to form the hollow sphere is already present in the 4-celled stage; gonidia with development arrested in early stages occur only occasionally.

Daughter coenobia reaching 200 to 250 μ (sometimes 300 to 350 μ) diameter before birth. Protoplasts at this time already rounded and always separated from one another by gelatinization of the cell membranes. Gonidia and androgonidia frequently more or less advanced in development at this time.

Distinction between asexual and sexual coenobia not sharply maintained. Among asexual and sexual coenobia are coenobia

[1] Zimmermann ('21, p. 260) gives the cell numbers in material collected by him in the vicinity of Freiburg in Brunswick, Germany, in the spring of 1919 as mostly fairly uniformly 1,024. In rare cases he found 2,048-celled coenobia. In cultures that were deteriorating the cell numbers fell to as low as 256. These numbers are based on his opinion that in the development of the coenobia all the cells of the embryo formed from the gonidium undergo the same number of divisions. This should dispose of the assertion of some of the earlier authors, Goebel ('82), and Goroschankin ('75), repeated by Oltmanns ('04) that the four cells forming the anterior polar group in the 16-cell stage do not undergo further division.

[2] Zimmermann ('21, p. 262) has shown that the gonidia are not differentiated from the somatic cells until after the last cell division by which the full number of cells of the coenobium is produced.

with all possible intermediate combinations of reproductive bodies; antheridia and daughter coenobia, oogonia and daughter coenobia, and finally antheridia, oogonia, and daughter coenobia in the same mother coenobium.

The sexual coenobia are more commonly dioecious, but also monoecious, and then usually proterogynous, though rarely proterandrous or with both sexual elements maturing at the same time.

The male coenobia, the so-called "Sphaerosira," (when maturing within the mother coenobia, called "Endosphaerosira") bear very numerous androgonidia, the number averaging between 300 and 500, though sometimes as great as 1,100.

Androgonidia round like the somatic cells, 9 to 12.5 μ in diameter before segmentation, connected with each neighboring protoplast by only one, two, or at most three connecting filaments; formed from about one-third of all the cells of the male coenobia; numbers in combination with other reproductive bodies at most 12 to about 24.

Antheridia usually in the form of platelets 12 to 18 μ wide with at most 32, though less often 16 or only 8, spermatozoids.[3] More than 32 spermatozoids in an antheridium is exceptional. In some cases antheridia form hollow spheres of spermatozoids. These may reach diameters of 30 to 48 μ, and contain many more sperms than do the platelets.

The spermatozoids are 8.5 to 12.5 μ long and 2 to 3 μ thick; the chloroplast is clearly leaf green; the nucleus is roundish and contains a nucleolus; the cilia are terminal on the end of a short colorless beak at the base of which are two contractile vacuoles and a stigma. The antheridia discharge the platelets or globoids into the water before the spermatozoids separate.

[3] Zimmermann ('21, p. 270) determined that the number of chromosomes in the nuclei is the same in all stages of the antheridium as in the vegetative development of the coenobia. In the 16-cell stage of the coenobia developing from oospores he counted the same number, thus establishing that, though the zygotes are diploid with respect to the chromosome number, the coenobia are haploid. Zimmermann also found that in the sixteen or thirty-two cells of the slightly cupped platelet of spermatogenous cells the nuclei do not migrate from the concave to the convex side of the platelet, as in the newly developed coenobia, but remain at the ends of the cells forming the concave surface of the platelet. In this respect it is to be expected that the species of *Volvox* having globoid antheridia will be found to differ from *Janetosphaera*, and it may be that the difference will be found to extend to those antheridia of *Volvox* that form platelets of sperms.

The oogonidia occur in numbers ranging from 1 to 15 like the gonidia, though mostly 3 to 8, and more seldom 6 to 10.

The oospores are spherical, with two somewhat eccentric smooth membranes. They are brownish red (orange red in glycerine), and measure 60 to 65 or even 70 μ in diameter.

In regard to the foregoing synopsis of the characters of *Janetosphaera aurea* (Ehrenberg) Shaw, as stated by Klein ('90) under the name of *Volvox aureus* Ehrenberg, it is to be remarked that incorporated therein are characters drawn from material wrongly identified by Klein as of this species. The material collected by Doctor Migula at Karlsruhe and described by Klein ('89A, figs. 1 to 8) under this name appears clearly from the figures to be at most a variety of *Volvox carteri* Stein. The latter is so different from the earlier described species of *Volvox* that it has been made the type of another genus, *Merrillosphaera* (Shaw '19, p. 512, footnote), described in another paper. Possibly still other species contributed some of the material to the make-up of this composite synopsis. The preparation of a true statement of the characters of *Janetosphaera aurea* is a task for someone familiar with the species in its European habitat and one to be undertaken with the related species and genera that have been found in other quarters of the globe in mind.

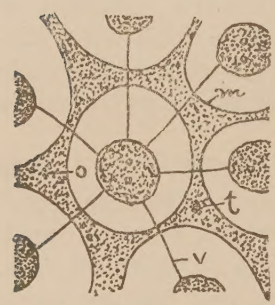

FIG. 1. *Janetosphaera aurea* (*Volvox aureus*). Diagram of cells and membranes as seen in surface view. After Meyer.

The most important addition made to our knowledge of *Janetosphaera aurea* subsequent to the accounts of Klein ('89 and '90) and Overton ('89) is the description by Meyer ('96) of the cell membranes of the somatic cells. According to this account each somatic protoplast is surrounded by a thick gelatinous wall that is separated from that of the neighboring protoplasts by a firmer middle lamella (text figs. 1 and 2, *m* and *m'*). Continuous with this middle lamella there is a cuticular covering that bounds the gelatinous membrane on the outer side. This is united with a common cuticular membrane, *p*, covering the coenobium. But on the side of each cell toward the center of the coenobium there is no firmer limiting membrane near the protoplast. The intercellular middle lamella, *m'*, is simply attenuated toward the center of the coenobium and extends far in that direction, the lamellae of different ages being attenuated

and extended to different degrees. So each protoplast is not inclosed in a little lamellar box of its own, as in *Volvox globator*, but occupies one of a layer of peripheral stalls each of which opens toward the interior of the coenobium into a segment of the central space that is shared by a number of protoplasts together.

JANETOSPHAERA FROM CALIFORNIA

My personal knowledge of *Janetosphaera aurea* is limited to that obtained from observations on two preparations in glycerine of material collected and mounted by myself at Stanford University, California, North America, in April, 1896. The material had been fixed and stained in picro-nigrosin and mounted under cover glasses that were then sealed to the slides by rings of Brunswick black. The staining had been very light, and the glycerine in which the specimens were mounted was slightly tinged with picric acid. After eighteen years the specimens, in 1914, as previously noted (Shaw, '19, p. 514), were in good condition; but the cement had become cracked and loosened to such an extent that it seemed advisable to remount the material. Before this was done some notes were taken that will serve as the source of the following descriptive data pertaining to *Janetosphaera aurea* found in California.

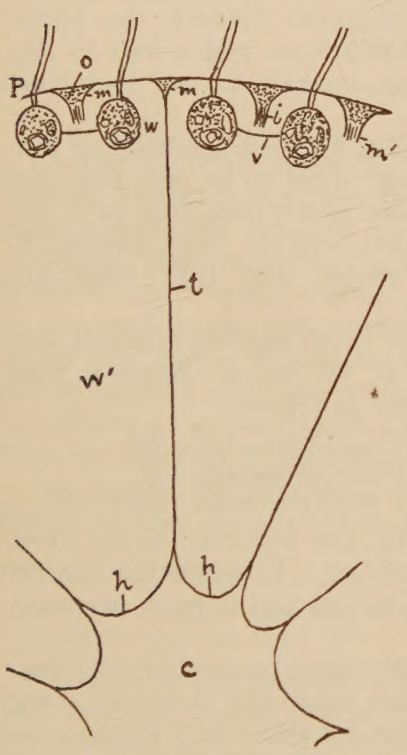

FIG. 2. *Janetosphaera aurea* (*Volvox aureus*). Diagram of cells and membranes as seen in cross section of coenobium. After Meyer.

The material in question consisted of twenty-five asexual coenobia on one slide and thirty-nine sexual and three asexual coenobia on the other.

Measurements made of coenobia were: Asexual, 300 by 330 μ and 320 by 330 μ; sexual, 400 by 425 μ and 640 by 700 μ. Estimates of the numbers of cells in these coenobia gave, in round numbers, respectively, 1,200, 1,800, 2,600, and 8,600 These estimates were made by counting the cells in areas 90 μ square under a square-ruled eyepiece micrometer and making

the calculation as described in an earlier paper (Shaw, '18, p. 256).

The somatic protoplasts are ovoid and have slender connecting filaments such as have been shown in the high-power drawings of Klein ('89 A, figs. 5 and 26), Overton ('89, fig. 1), Meyer ('96, pl. 8, fig. B), and Janet ('12, fig. 4). Measurements of average protoplasts in the four coenobia above noted gave 7 to 8 μ in the first and 5 μ in the others.

The somatic protoplasts are farther apart about the anterior pole and closer together about the posterior pole than they are in the equatorial region. The distances between the protoplasts in the first coenobium are about one and a half to two protoplast diameters forward and one-half to one protoplast diameter aft.

The number of connecting strands between neighboring protoplasts in the first coenobium was noted to be one, two, and three, and in the second coenobium mostly one, and in a few cases two. It was also noted that strands from somatic to reproductive protoplasts were visible, but they were not counted.

The asexual reproductive bodies in 25 asexual coenobia and the female reproductive bodies in 39 sexual coenobia were counted and found to be distributed as follows:

4, 5, 6, 7, 8, 9, 10, 11, and 12 reproductive bodies in
3, 4, 10, 5, 2, 1, 0, 0, and 0 asexual coenobia and
2, 6, 5, 13, 5, 3, 2, 2, and 1 female coenobia, respectively.

Thus the number of gonidia in this material ranges from four to nine and is most commonly six. Likewise the number of oogonidia ranges from four to twelve and is most commonly seven.

Daughter coenobia in one mother were measured. Of four daughters, two in the 16-cell stage measured about 36 μ and two in about the 64-cell stage measured about 54 μ in diameter. Another coenobium contains seven reproductive cells (and one or possibly two vacant sites of such cells) that are ovoid—six measuring 40 by 45 μ and one 25 by 35 μ. In the nearer hemisphere of this coenobium two cells larger than the somatic cells (10 μ in diameter) are visible. They are located about three or four cells distant from the nearest reproductive cells.

Oospores counted and measured in one coenobium were seven, with diameters of the zygote protoplasts 53 to 57 μ and of the outer spore wall 67 to 73 μ. In the largest coenobium there were ten oospores, their protoplasts being about 60 μ and their

outer wall about 79 μ in diameter. The spore walls are smooth, and the zygote protoplasts are eccentric within them. These are immature spores.

Mature oospores have, in addition to the spherical smooth outer wall, a much smaller spherical smooth inner wall that is eccentric and in contact with the outer wall on one side. The specimens are now under slight pressure of the cover glass and the spores may be slightly flattened and widened. In one of the mature oospores the outer wall measures 75 μ in diameter, the inner wall 62 μ, and the protoplast 57 μ.

VOLVOX Linnaeus

(*Volvocaceae, Volvoceae*)

Type species, *Volvox globator* (L.) Ehrenberg.

Characters which serve to distinguish the species properly included in this genus from species that should have places in other genera are embraced in the following diagnosis:

Globose, free-swimming bodies, consisting of very numerous biciliate cells forming a peripheral layer; the protoplasts more or less star-shaped and covered with thickened walls through which neighboring protoplasts are connected by stout protoplasmic processes; each cell containing a green chloroplast. The cell membrane typically with a firmer lamella cutting off the cell from the interior of the body.

The descriptive diagnosis of the type species as given by Klein has been transcribed in the following paragraphs.

VOLVOX GLOBATOR (L.) Ehrenberg (fide Klein, '90, pp. 82–84).

Volvox stellatus Ehrenberg 1831.
Volvox monoicus Cohn 1875.

Coenobia usually somewhat elongated, seldom exactly spherical; diameter mostly 600 to 800 μ, occasionally ranging from 400 to 1,200 μ.

Somatic cells mostly about 10,000; ranging from 1,500 to 22,000.

Somatic protoplasts 2 to 7.5 μ, usually 3 to 5 μ, irregularly star- or amoeba-shaped, mostly somewhat crowded; chloroplast extending into the cytoplasmic processes, which are almost always simple and usually, even when the chloroplast processes are withdrawn, considerably thicker than the cilia.

Gonidia of the same form (amoeba-shaped) as the somatic cells, becoming 15 to 18 μ in diameter before the first division, connected with the neighboring somatic cells only by single pro-

toplasmic connecting filaments; almost always only eight divide, seldom more (though occasionally as many as 14) and more seldom less. Bending to the hollow sphere begins mostly in the 8-celled stage. Besides these there occur in the asexual coenobia not infrequently a larger number (10 to 30) of undivided or once-divided gonidia which do not develop further.

The daughter coenobia reach at time of birth mostly a size of 150 to 200 μ (very seldom more, though sometimes as much as 320 μ); at this time the somatic cells are hexagonal from mutual pressure, the cell membranes not thickened, and the gonidia and androgonidia are not yet fully developed and still undivided.

The sexual coenobia are normally always monoecious and usually proterandrous, though sometimes the eggs and spermatozoids mature simultaneously in the same coenobium.

The androgonidia have the amoeboid form of the gonidia and nearly the same size, reaching about 15 μ; their number is somewhat variable, usually about five become functional, though sometimes as few as one or as many as fifteen.

The antheridia are platelets or hollow spheres of numerous spermatozoids, seldom less than 100, often very many more. Diameter of the antheridial sperm bundles 23 to 34 μ [according to Cohn ('75, p. 18) 35 to 44 μ].

Spermatozoids 5 to 6 μ long with pale green or yellowish chloroplast; a very long colorless beak at the base of which two long cilia are inserted near the stigma and the two contractile vacuoles. Rarely the cilia are borne on the end of the beak. The nucleus is rod-shaped (Overton, '89, p. 30) and without a nucleolus.

The sperm bundles and spheres partly break up within the mother coenobium and partly are discharged into the water where the constituent spermatozoids separate.

The gynogonidia early become rounded off and reach a size of 44 to 50 or even 56 μ. They number 20 to 64, mostly about 30. The oospore has a smooth inner membrane and a stellate prickly outer membrane. When ripe they are brownish red (in glycerine clear orange red).

To the foregoing synopsis of the characters of *Volvox globator* Ehrenberg, as stated by Klein ('90), two features that have been brought to light more recently may be here appended.

The oospore has been found by Janet ('14, p. 6, fig. 1) to consist of a large zygote inclosed in a thin spherical follicle formed of a

layer of atrophied cells,[4] this being surrounded in turn by inner and outer spore walls. The atrophied cells he regards as somatic cells of a dwarf female coenobium of which the gynogonidium proper is the single reproductive cell.

The cell membranes of the somatic cells, first adequately described by Meyer ('96) were diagrammatically shown in elaborate figures by Janet ('12, figs. 1, 2, 3, and 6) in his comprehensive monograph on *Volvox*. According to Meyer's account, illustrated by his diagrammatic figures that are reproduced here as text figs. 3 and 4, the cells of *Volvox globator* are short prismatic, 6-sided as seen in surface view (fig. 4) and rectangular as seen in a section normal to the surface of the coenobium (fig. 3). A fine, relatively thick membrane lamella, *m*, that he called the

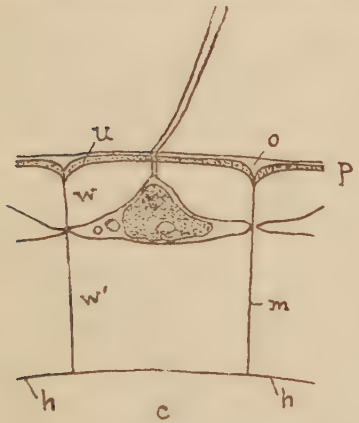

FIG. 3. *Volvox globator.* Diagram of cell membranes as seen in a cross-section view of a portion of the coenobium wall. After Meyer.

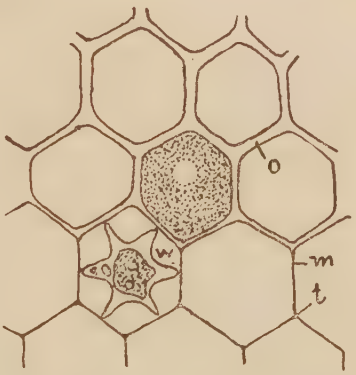

FIG. 4. *Volvox globator.* Diagram of cell membranes as seen in surface view and tangential sections of the coenobium wall. After Meyer.

"Hülllamella," unites the cells. The peripheral lamella, *p*, forming the outer boundary of the coenobium, is relatively thick. The lamella, *h*, bounding the cell toward the interior of the coenobium is of the same thickness as the lateral part of the lamella, *m*. The space between the "Hülllamella" and the pro-

[4] Unfortunately Janet's preliminary note on the egg of *Volvox globator* was overlooked by Zimmermann ('21) at the time of the preparation of his most valuable paper on the development and cytology of *Volvox*, and the latter gives no account of the development of the oogonidium of this species. So we still await detailed confirmation of Janet's account of the oogonidial follicle. Although nothing like this follicle was found by Zimmermann in the investigation of his material of *Janetosphaera aurea*, making it appear that the absence of such a follicle constitutes a difference between these genera, still the results will be more conclusive when we have a definite report on the subject made with this point in mind.

toplast is filled with a jelly, *w* and *w'*. Between the peripheral lamella, *o*, and the jelly, *w*, there is a soft mass, *u*, that differs somewhat from the jelly. The "Hülllamella" and the jelly together were regarded by Meyer as constituting the cell wall and directly comparable with the cellulose walls of the higher plants. The gelatinous layer of the membrane contains canals that are filled by extensions of the protoplast so that the protoplast is star-shaped. According to Meyer the cavity of the coenobium within the layer of cells is occupied by a watery liquid. Janet ('12, p. 34) found the interior of the coenobium to be filled with a jelly made up of radial columns, one extending to near the center from each of the peripheral cells of the coenobium.

VOLVOX PERGLOBATOR Powers.

This species was described by Powers ('08) from shallow pools in the neighborhood of Lincoln, Nebraska, North America. In his paper dealing with the subject he reported it also from the following North American localities: Rocheport, Missouri; St. Louis, Missouri; New Orleans, Louisiana; the vicinity of Ann Arbor, Michigan; and the neighborhood of Sebago Lake, Maine. He also reported that material he had seen from the states of Washington and Massachusetts probably belonged to the same species. The description was without illustrations.

The form of the coenobium was not stated except for the large female coenobia, which were called oval by Powers. The size reached more than 1,000 μ in some of the asexual coenobia of each of Powers's collections, while coenobia of 1,200 to 1,400 μ were readily obtainable, and one old furrowed coenobium of 1,600 μ was measured. Many of the female coenobia from the same source as the largest asexual coenobium were about 1,000 μ in diameter and sometimes larger than this in the longer dimension.

The number of somatic cells was not given, though they were characterized as excessively numerous. The characters of these cells were stated to coincide closely with those of *Volvox globator*. They were called highly stellate and reported to duplicate the figures by Overton ('89) and Meyer ('96) of the somatic cells of that species. In the oldest sexual coenobia the somatic protoplasts became widely separated from one another and their cytoplasmic processes extended in irregular bent lines until the cell bodies were hardly noticeable and the somatic layer pre-

sented the appearance, under a moderate magnification, of a spongelike reticulum. Powers was able to observe perfectly the extremely delicate connecting fibrils such as Meyer had found to form connections between the cytoplasmic processes of neighboring protoplasts.

In some instances pairs of neighboring somatic cells were found with protoplasmic processes that quite penetrated the cell membranes and united the protoplasts by a bridge of cytoplasm that was little narrower than the diameters of the protoplasts. These would seem to be cases in which the cell divisions had never been normally completed.

In regard to the gonidia and the development of the asexually produced coenobia no particulars were given.

The sexual coenobia were dioecious, the separation of the sexes being uniform. Among thousands of coenobia Powers found but a single exceptional instance. That was an enormous female coenobium loaded with oospores which showed on one side a single well-developed antheridium, while near it a vacant space was evidence of the discharge of the contents of another. The combination of oogonidia or androgonidia in the same coenobium with gonidia is in this species only an anomaly. Powers saw but three such coenobia.

The oogonidia were produced in large numbers, often exceeding 100 in poorly developed material, while in the material first obtained there were not infrequently between 300 and 400. Powers believed that counts would show considerably higher numbers. There was a small area of purely somatic cells about the anterior pole of the female coenobium. The oospores were described as crenate zygotes.

The male coenobia varied greatly in size, number, and manner of development. Sometimes they developed all their antheridia nearly simultaneously, at other times their development was spread over a considerable period, nearly all stages being present at one time. Old coenobia were found that were almost devoid of androgonidia or antheridia, all or nearly all of the spermatozoids having been discharged. In most of the coenobia the number of antheridia was very high, there being usually from fifty to one hundred fifty androgonidia or antheridia in one coenobium.

The antheridia are hollow, globular bodies, strangely like a minute coenobium. As the sperm cells become developed into spermatozoids the globular body becomes much flattened, re-

taining, however, its cavity and showing spermatozoids with cilia directed outward on all sides. These cilia do not project similarly from all of the spermatozoids; one side, even while the globoid is still within its parental lodgment, always shows the cilia radiating from a center; toward the periphery they bend around the sides and extend straight backward, as do all those on what may be called the posterior side.[5] The sperm masses seem always to escape outward into the surrounding water, never into the interior of the coenobium. Among material rich in male coenobia these groups of sperms were readily found, swimming with vigorous independence among the various coenobia. The locomotion of the sperm globoids is by a rapid spiral rotary movement with one pole habitually directed foremost.

The number of sperms in a globoid was not estimated, though it was thought to be twice as great as the maximum number that had been given previously for the sperm platelets of any species. The sperm globoids were subject to some variation. In material from climates less sunny than that of Nebraska, as Maine and Michigan, the globoids do not always become complete. The form is the same, but a small round opening remains on one side.

The spermatozoids, Powers stated, are shorter and smaller than any he had seen before.

Photomicrographic figures used by Harper ('18) to illustrate his paper on binary fission in *Volvox* all appear to represent a true *Volvox* rather than a *Janetosphaera*. They show stages in the segmentation of the gonidia. It may be that these are the only figures yet published that show anything of *Volvox perglobator*.

VOLVOX ROUSSELETI West.

This species was based on asexual coenobia collected from a pool near the station at Gwaai in Rhodesia, Africa, by C. F. Rousselet, in September, 1905. The description by West ('10) is illustrated by photomicrographic figures of young and old coenobia and of a group of somatic cells. West ('18) supplemented the original description by giving an account of sexual and mixed coenobia that were found in material collected by A. W. Jakubski, on his trip of 1909–10, in the Ussangu Desert,

[5] The posterior side is probably the region about the site of the phialopore.

in what was then German East Africa. These were illustrated by photomicrographic figures of two male, one mixed (male and asexual), and one female coenobium, the latter containing mature oospores, and by a drawing of a ripe oospore.

The adult coenobia were described as large and globose, measuring 1,125 to 1,240 μ in diameter. The figures show the mixed and male coenobia (West, '18) as somewhat elongated, and give measurements of 1,090 to 1,240 μ in width and 1,340 to 1,400 μ in length. The number of cells was stated to vary from about 25,000 to rather more than 50,000. Estimates of the cells shown in the figures of male and mixed coenobia range between 32,000 and 35,000. The protoplasts of the somatic cell are 4 to 6.5 μ in diameter. In surface view they are somewhat angular and appear to possess relatively stout protoplasmic processes connecting them with their neighbors. The spaces between neighboring protoplasts are narrower than the breadths of the protoplasts. Thus there is a dense crowding of the protoplasts that gives the coenobia a very robust appearance.

The number of gonidia formed in a coenobium was regularly eight. From the micrographic figures showing daughters, it appears that the gonidia are very regularly and symmetrically arranged; four are equidistant in a transverse plane through or very slightly in advance of the equator, and the four others alternate with the first four in a transverse plane midway between the equator and the posterior pole.

The daughter coenobia were set free when each had a diameter of about 370 μ. At this stage the protoplasts apparently touched one another, and they continued to do so almost up to the time when the coenobia reached a diameter of 800 to 850 μ. The first formation of daughter coenobia was observed in mother coenobia of that size. From this it appears that the gonidia are not differentiated in size from the somatic cells until some considerable time after the birth of the coenobia in which they are formed.

The oogonia and androgonidia are produced in different coenobia, though gonidia and androgonidia occur in the same coenobium (West, '18, fig. 2).

The number of oogonidia or oospores in a coenobium was stated to range from 120 to 150 and to average 128. The figure (West, '18, fig. 8) shows them to be absent about the anterior pole.

The oospores are shown and described as densely clothed with strong conical spines. Their average diameter without the spines is given as 44 μ and the length of the spines 11 to 12 μ.

The androgonidia are described as very numerous in each male coenobium; usually there are several hundred. They are absent about the anterior pole. The antheridia, though shown in the photomicrographs of three coenobia (West, '18, figs. 1, 2, and 7) on a scale of 50 diameters, were not described. Presumably they were regarded as so similar to the antheridia of the European species of *Volvox* as not to call for particular description. This is unfortunate, because of the considerable variation in the antheridia in the species of *Volvox* from other parts of the world. The spermatozoids, naturally, were not described, the material having been preserved in formalin.

VOLVOX MERRILLI sp. nov.

For the type of this species the specimen represented by Plate 1, figs. 1, 2, and 3, and Plate 2, fig. 4, has been selected. The specimen appears to have been fixed in a picro-nigrosin solution, which stained it lightly, and to have been mounted with others from the same collection under a sealed cover in glycerine, concentrated from a 10 per cent solution by evaporation. The mounting fluid is strongly tinged with picric acid.

The upper and lower sides of the specimen as mounted require a difference in focal adjustment of about 300 μ as indicated by a Zeiss side-focus fine adjustment. Assuming a refractive index of 1.4 for the mounting medium, I estimate the thickness of the specimen at about 420 μ. The short and long diameters of the coenobium measure about 690 and 750 μ, respectively. By a camera lucida sketch method described in another paper (Shaw, '18, p. 256) from a count of 62 cells in an area of 8,100 sq. μ the number of cells in the specimen was estimated to be about 12,100. The spacing of the somatic cells is fairly uniform for any particular part of the colony, and they lie in tolerably regular rows of various curvatures. The average distance between the centers of the cells of this specimen is about 11 μ in the equatorial region, about 18 μ around the anterior pole, and very little less than 11 μ near the posterior pole.

The protoplasts are roundish, unequally angular, about 4 μ in diameter. (In immature sexual coenobia the protoplasts measure 6 to 7 μ.) Their outer ends are between 1 and 2 μ from the outer limiting membrane of the colony. Their protoplasmic processes proceed from below the middle of each. The outer surface of the colony is nearly smooth, though very slightly wavy about the anterior pole. No inner limiting mem-

brane (toward the center of the coenobium) of the somatic cells is visible in the specimen. The connecting filaments mostly show a pair of nodes near their middles. There is but one direct filament between any two neighboring protoplasts, but some protoplasts send out one filament to a neighbor and another to a filament connecting that neighbor with a third protoplast, and others send out two filaments which unite with two processes connecting the same neighbor with two other protoplasts.

The oospores in this specimen were all sketched in outline with a camera lucida and counted. The number is 92. There are none in the anterior fourth or fifth of the colony. They all lie near the periphery of the colony, 29 to 39 μ below the outer membrane. They are fairly evenly distributed in the area which they occupy, though showing considerable grouping in pairs, and leaving vacancies at what I suppose to be the sites of antheridia, of which there are about three on the upper and the same number on the lower side.

The outer wall of the spore is developed into hollow spines, of which peripheral counts in the median optical section give from 14 to 16, averaging 15, a number which corresponds to a total of about 82 on the spherical surface. These spines are nearly 11 μ high, and their bases are close together. The basal two-fifths of each spine is broadly conical, most of the remainder is more narrowly conical with a tip which is more broadly conical. Many of the spines are somewhat inclined to one side. The thickness of the wall of the spines does not show clearly with the highest power that can safely be applied, but this wall does not seem to be thick. It has a brownish yellow color. The diameters of the spores measured between tips of spines are about 60 μ, between bases of spines about 40 μ.

The oospores measure in diameter 30 to 32 μ, averaging 31 μ. The protoplasm is densely granular and yellowish. Within it there is a dark red spherical body which seems to be the nucleus. It may have been stained with some stain the use of which was not recorded. Its diameter is a little more than two-fifths that of the protoplasts, and it is located excentrically about one-fifth of the protoplast diameter from one side. Close beside this red body there is a clear space or transparent body about half as thick as long, its length being a little less than the diameter of the red body. It lies somewhat nearer to the periphery of the protoplasts than does the red body.

More or less directly over each oospore, seen in surface view of the colony, there is a vacancy in the layer of somatic cells, the site of the cell before it became the egg or egg apparatus. There are other, larger vacancies, as before mentioned, of which two show plainly in the photograph (Plate 1, fig. 1), that are supposed to mark the sites of antheridia. A few cells here and there in the somatic layer are larger, having diameters two or three times as great as the average for somatic cells.

The specimen is in good condition, the greatest damage it has suffered being a crease or furrow formed on the right side, from the equator forward halfway to the anterior pole, by a grain of sand which lies in the deeper end of the furrow.

The material from which this specimen was taken was collected from a seasonal pool (carabao wallow) about 5 meters in diameter and 80 centimeters deep, without inlet or outlet, in a grassy field in Pasay, about 1 kilometer south of Manila, September 16, 1914. At the time the pool was about half emptied by evaporation and seepage. The pool was designated by the letter A for the purpose of labeling the material taken from it on this and later dates.[6]

In several mature female coenobia on the same slide with the type specimen there is occasionally a smaller oospore among the others. One such is shown in Plate 2, fig. 5. This is from a coenobium containing 77 oospores. The large oospores measure about 42 μ, exclusive of the spines, and the spines are about 11 μ high. The spores measure about 64 μ over all. The small spore measures about 37 μ, without the spines, the spines are about 6.5 μ high, and the width of the spores over all is about 50 μ. The wall and the spines of this small spore are thinner and the spines less crowded than on the larger spores. The walls of these small spores resemble those of the next species to be described.

The numbers of oospores counted in some of the coenobia on the same slide with the type specimen were: 129, 92, 90, 77, 67, 60, 57, 47, and 38, the larger numbers being in larger coenobia and the smaller numbers in smaller ones.

[6] The slides bearing the type specimens of this and of the other Philippine species of *Volvox* are in my possession. Slide mounts of material from the same collections have been sent to Prof. Frank G. Haughwout, Bureau of Science, Manila, and to Prof. Douglas H. Campbell, Stanford University, California. Material from the type locality, bottled in glycerine, has been sent to sixteen biologists in North America and to sixteen in Europe and Asia. Duplicates of this bottled material are available for distribution from my American address; Claremont, California.—W. R. S.

No very mature asexual coenobia were found in this lot of material. Several were at about the stage represented by the one shown in Plate 3, fig. 11. This coenobium contains about 17,800 cells, with protoplasts of about 6 to 8 μ diameter, and seven embryo daughters of about 80 μ diameter. Four of these daughters are about in the equatorial plane of the coenobium and the others near the hinder pole. Another similar asexual coenobium has eight daughters, of which four near the equatorial plane are about 80 μ, two on one side near the hinder pole about 65 μ, and two on the other side near the hinder pole about 30 μ. Still another similar asexual coenobium, one with about 20,000 cells, has four daughters of about 73 μ near the equatorial plane, and four alternating with them nearer the hinder pole that measure 45 to 59 μ.

Smaller coenobia with fewer daughters are represented by the one shown in Plate 3, fig. 7. This measured about 360 by 390 μ, had about 5,000 cells, and contained two embryo daughters of about 46 μ diameter.

A much smaller one is shown in Plate 3, fig. 10. This one measured about 200 μ in diameter, had about 1,145 cells, and contained three embryos of about 27 μ diameter in about the 8-celled stage.

One from a different lot of material is shown in Plate 3, fig. 8. This is about 285 by 300 μ, has about 2,400 cells, and contains eight reproductive bodies that are from two to five times the diameter of the somatic cells.

Young coenobia of the species are very numerous on the slides of the type material and in other collections. Two such young coenobia are shown in Plate 3, figs. 6 and 9. The preparation from which these were photographed has dried up. But they may be fairly well described from the photographs. The older of the two is certainly a sexual coenobium, and the younger is probably also. The younger (fig. 6) measures about 530 by 540 μ and has about 18,000 cells. In it can be seen a sperm globoid in an advanced stage of development, an androgonidium divided into four cells, and another divided into two. The oogonidia are not yet differentiated. The older (fig. 9) measures about 490 by 550 μ and has about 9,500 cells. In it can be seen two sperm spheres in different stages of development, and numerous scattered cells of about twice the diameter of the somatic cells. These must be oogonidia.

Coenobia with both asexual and sexual reproductive bodies were observed among the material from pond A. One of this

kind has four embryo daughters distributed symmetrically about the hinder pole and dominating the hinder two-fifths of the coenobium. The forward fifth is without reproductive bodies and in the remaining two-fifths or less are oogonidia that form a zone around the coenobium. The oogonia are more advanced in development on the forward side of the zone, and more backward toward the hinder side of the zone. Among the oogonia are the sites of six or more antheridia that are marked by empty places. In another mixed coenobium with four daughters the zones of sexual and asexual bodies are not so far separated. In still another there is present also, among the oogonia, a rather large sperm globoid. In one case there are two daughters with a small number of oogonia, and in another two daughters with a rather large number of oogonia. In a similar lot of material there are two cases of coenobia with a group of five embryo daughters and a zone of oogonia. In one of these the zone of oogonia is narrower on one side.

It appears from consideration of the aforementioned cases that in this species the asexual and sexual reproductive bodies are typically formed in separate coenobia; also, that the male and female bodies are formed in the same coenobia, the former maturing first; and, further, that when occasionally sexual and asexual bodies are formed in the same coenobium they are distributed as if in different segments of the coenobium. In the cases described the asexual bodies are in hinder segments, the sexual in intermediate segments, and nothing in the forward segments.

The size of the mature asexual coenobia is not shown by any of the material at hand. Referring to the largest pictured specimen (Plate 3, fig. 11) we find that this coenobium, having daughters of about 80 μ diameter, measures about 750 μ. In view of the fact that the daughters probably grow to more than 300 μ diameter before birth it is evident that robust asexual coenobia when mature reach a diameter of about 1,000 μ.

VOLVOX BARBERI sp. nov.

The specimen represented by Plate 4, figs. 13 and 14, has been selected for the type of this species. This specimen appears to have been fixed in a chrom-acetic solution, lightly stained with a reddish stain, and mounted with others from the same collection under a sealed cover in glycerine which had been concentrated from a 10 per cent solution by evaporation.

The upper and lower sides of the specimen require a difference in focus of about 370 μ. An estimate of the thickness

of the specimen compressed under the cover, based on an assumed optical density of the mounting medium of 1.4, is 518 μ. The short and long diameters of the specimen measured about 790 and 930 μ. The number of cells in the specimen was estimated to be 31,500 by assuming a mean diameter of 737 μ and counting 149 cells in an irregular space, taken near the equator, having an area of 8,100 sq. μ. The distribution of the somatic cells is not so regular as might be expected, many of the cells standing closer to one neighbor than to the others. The average distance between centers of somatic cells is about 8 μ in the equatorial region, about 14 μ around the anterior pole, and about 7 μ near the posterior pole.

The protoplasts vary from ovoid at the anterior pole to pear-shaped at the posterior pole. The surface view shows them roundish with one, two, or sometimes more angles, and about 3.5 μ in diameter. The hexagonal intercellular membranes can barely be made out. The one, two, or more angles of the protoplasts are the bases of more prominent filaments. Most of the intercellular filaments are hardly visible. Between any two neighboring protoplasts there is no indication of the occurrence of more than one filament. In the median optical section of the coenobium there is to be seen a clearly defined inner membrane about 22 μ within the outer membrane of the colony. The protoplasts occupy a portion of the outer third of the space between these two membranes.

The oospores in this specimen, numbering about 224, were, as nearly as practicable, all sketched with a camera lucida for counting. An obstacle that precludes absolute accuracy in this sketching is the overlapping of the oospores at the sides of the colony, which is greater than at the posterior pole. There are no oospores in the anterior quarter of the colony, and there is a scarcity of them about the posterior pole. They all lie near the periphery of the colony, within and close to the inner membrane which, as before stated, is about 22 μ below the outer membrane. The wall of the spore (see Plate 4, fig. 14) is developed into spines which are rather broadly conical in form. These spines do not stand so close together as those of the type specimen of *V. merrilli,* are not so long, do not have such attenuate form as in that specimen, and are more finely or sharply pointed. The spines appear to be hollow, thin-walled, and comparatively colorless, though the latter character may have resulted from action of the fixing agent. Their peripheral count is about fifteen. The diameter of the spore, including the

spines, is about 43 μ; excluding the spines, about 34 μ. The spines are about 3.5 to 5.5 μ high.

The oospheres vary, probably due to difference in degree of maturity, some nearly filling the spherical lumen of the spore wall, others being excentrically shrunken away from the wall, the latter being commoner in the posterior part of the colony. The protoplasm is coarsely granular in most of the oospores, and stained reddish, and the nucleus cannot be distinguished.

More or less directly over each oospore, seen in surface view of the colony, there is a vacancy in the layer of somatic cells. There are a few other vacancies, one on the upper and two on the lower side, in the layer of somatic cells, that are supposed to represent antheridial sites. Enlarged somatic cells are not noticeably present.

The specimen has a break running across the near side a little forward from the oosporic region, and a λ-shaped crease in the middle of the near side. Fungus hyphae on the left side of the anterior pole are a reminder of the futility of depending on exposure of glycerine to the atmosphere in shallow dishes for the purpose of evaporation. Some of these hyphae penetrate the colony. There are others on and in the lower side.

The material from which this specimen was taken was collected from a flood pool near the Pasig railway station, about 10 kilometers east of Manila, at some time between July 19 and August 31, 1914. The collection was designated by the Roman number V for the purpose of labeling slides prepared from the collection.

Scattered over the surface of the colony, embedded in the membranes, are numerous specimens of an endophytic alga that is considered to belong in the genus *Chlorosphaera* Klebs. A great variety of stages of the life history of this organism are present. The most conspicuous are the resting spores, of which a dozen are to be seen in Plate 1, fig. 1.

Six other equally mature female coenobia of about the same size and with about the same number of spores are present on the same slide with the type specimen. There are also two smaller ones with mature oospores, one about 545 by 708 μ with 73 oospores and the other about 430 by 516 μ with 65 oospores.

Immature female coenobia are also present. One measuring 580 by 600 μ has the oogonia about 20 μ wide, and another about 885 by 915 μ has oogonia about 25 μ wide. In the former the oogonia are only partly somewhat pear-shaped, in the latter

they are mostly so. In the former five or six partly developed antheridia are visible, and in the latter four can be seen, three of them sperm globoids and the other cup-shaped and probably immature. The preparation is not suitable for observing the details of the antheridia.

A nearly mature asexual coenobium with eight symmetrically arranged daughters is shown in Plate 5, fig. 15. This is on the same slide with the type specimen and therefore from the same collection. It is compressed under the cover to about 450 μ and measures about 950 μ in diameter. The number of cells in the mother was estimated variously at 30,000 and 38,000, and those in one of the daughters were estimated at about 26,000. This daughter is about 300 μ in diameter and has ciliated cells about 3.5 μ in diameter and closely crowded. It has also a few reproductive cells of about 10 μ. The layer of the somatic cells of the mother and their membranes is about 23 μ thick and the protoplasts are in the outer half of this thickness. The protoplasts in the front of the coenobium are larger, ovoid, and about 3.5 μ in diameter. Those at the back are smaller, pear-shaped, with the outer half about 1.2 and the inner half about 2.5 μ wide. In length they are as large as the forward somatic protoplasts. The protoplasts are spaced about 7 μ at the back and about 10.5 μ at the front. The connecting filaments are delicate.

On the same slide there are other mature asexual coenobia. One shows a rear view of a beautifully symmetrical group of eight daughters, two others show oblique views of the same number of daughters. Two others show seven large daughters each, but with a vacant space among the daughters. One mother with half-grown and one with one-fifth-grown daughters have also eight each. So eight seems to be the number of gonidia characteristic of this lot of material.

From a pond, C, in Pasay, several kilometers distant from the source of the type material, there was collected on September 20, 1914, and fixed on the next day, material of *Volvox barberi* that included asexual coenobia having the number of daughters variable.

One, shown in Plate 5, fig. 16, has only four daughters. They are distributed around the equator of the coenobium. The specimen presents nearly a side view and measures in the photograph 540 by 580 μ. The approximate correctness of the magnification of this figure is indicated by the scale reproduced below the figure. This scale is a reproduction of a stage mi-

crometer scale with smallest divisions 10 μ each, that was photographed on the same plate as the specimen, with the same adjustment of the apparatus. The daughters are about 125 μ in diameter and appear to be developing cilia on their cells. There are indications that three or four other reproductive bodies were present in the hinder half of the coenobium and distributed symmetrically. They were either abortive and degenerated, or they formed antheridia.

Another, shown in Plate 5, fig. 17, has six daughters that are shown in a posterior polar view. This is from another slide of the same collection. The somatic cells mostly appear too large because of being out of focus.

On the same slide with the coenobium having four daughters there are fourteen coenobia in about the same degree of maturity. They have—

3, 4, 5, and 6 daughters in
2, 5, 5, and 2 mother coenobia, respectively.

With the material just described there is a variety of stages of asexual *Volvox* coenobia ranging from young ones with gonidia of about 10 μ divided into two cells to older ones with the reproductive bodies many-celled. It is not evident at first sight that these are of the same species that is being described here, for the somatic cells of these young and intermediate coenobia are more robust than those of the type material of *Volvox barberi*, and they appear to be fewer in number. Still, I am inclined to believe that they are the same species. They show a tendency to have eight reproductive bodies, even when fewer are developing. In one such, for example, there are four embryo daughters of about 57 μ distributed equatorially and forming a symmetrical group, and halfway back to the hinder pole there is a group of four small reproductive bodies similarly arranged. One of these is simply a pair of twin stellate cells, each of not quite twice the diameter of the somatic cells. The three others are *Pandorina*-like bodies of about sixteen cells, measuring about 18 by 21 μ.

A small coenobium that appears to belong to *Volvox barberi* is shown in Plate 3, fig. 12. It measures about 210 by 250 μ and contains about 1,800 somatic cells. It is without reproductive bodies. It serves to illustrate how small and relatively few-celled some members of the large, many-celled species may be.

That coenobia of *Volvox barberi* sometimes occur with both asexual and sexual reproductive bodies is shown by a specimen

on the type slide. In this there are two bodies that appear to be diseased or parasitized daughters of about 73 and 88 μ diameter, in a coenobium of 680 by 760 μ. This coenobium has a large distinct vegetative forward area. The two daughters occupy positions corresponding to those of two adjoining members of a posterior quartet in a typical coenobium with eight daughters. The quarter sphere occupied by the two daughters is free from oospores. The latter are distributed, then, in the other posterior quarter sphere and around the equatorial margin of the forward half of the coenobium; that is, between the equator and the forward vegetative area. About one-third of the oogonia appear to have been unfertilized, for they are deficient in reserve material and have formed no spore walls. Those that have formed spore walls have developed them in considerable variety.

The variation in the spore walls of the aforementioned coenobium are noteworthy. A few are almost smooth; some are smooth with a few scattered rounded warts; a few are wavy to a very marked degree; and many have a smooth wall with numerous but not crowded conical warts or rounded warts. Some of these are of the form represented by Janet ('14, p. 7, fig. 1) for *Volvox globator*. They vary in size, but an average one measures about 42 μ over all and 34 μ without the warts, the latter being about 4 μ high or less. On some spores the warts are rounded and on others conical.

A COMPARISON OF THE SPECIES OF VOLVOX

Considering only the species here classified as *Volvox* there are five; *Volvox globator* of Europe, *V. perglobator* of North America, *V. rousseleti* of Africa, and *V. merrilli* and *V. barberi* of the Philippine Islands.

To facilitate a comparison of these species some of their characters have been set down in parallel columns in Table 1. The data here used are not all uniformly representative of the species to which they pertain, but it is thought that they will serve as a good first approximation.

The best means of distinguishing between the two Philippine species of *Volvox* is by the size and form of the somatic cells of the coenobia. Those of *V. merrilli* are relatively large, wider than high, and stellate, much like those shown in Meyer's drawings of those of *V. globator* reproduced herewith as text figs. 3 and 4. Those of *V. barberi* are smaller, higher than wide, and vary from more or less stellate in younger coenobia to ovoid about the forward pole and pyriform about the hinder

TABLE 1.—*Characters of the species of Volvox.*

Distribution and characters.	*V. globator.*	*V. perglobator.*	*V. rousseleti.*	*V. merrilli.*	*V. barberi.*
Geographical distribution	Europe	North America	Africa	Philippine Islands	Philippine Islands.
Coenobia, form	Subglobose	Asexual unknown; female oval.	Asexual subglobose; sexual ellipsoidal.	Asexual subglobose; sexual ellipsoidal.	Asexual subglobose; sexual ellipsoidal.
Coenobia, size	420 to 800 μ	1,000 to 1,600 μ	1,125 to 1,240 μ	Asexual about 1,000 μ; sexual 690 by 750 μ.	Asexual 950 μ; sexual 790 by 930 μ.
Cells	1,000 to 15,000	Excessively numerous	25,000 to 50,000	Asexual 17,800; sexual 12,100.	Asexual 31,500; sexual 30,000.
Protoplasts, form	Stellate in surface view	Stellate in surface view	Stellate, small, densely aggregated.	Stellate; wider than high	Stellate to ovoid and pyriform, very small; higher than wide.
Protoplasts, size	3 to 5 μ	3 to 5 μ (implied)	4 to 6.5 μ	4 to 8 μ	3.5 μ and less.
Protoplasmic connections	Thick and continuous with the processes of the protoplast.	Becoming long and slender.	Relatively broad	Coarse; becoming finer and longer.	Fine.
Gonidia	8, seldom more or less		8	8 or less	8 or less.
Oogonidia	12 to 40, average 30	More than 100; even 300 to 400.	120 to 150; average 128	129, more or less	224, more or less.
Oospore wall	Verrucose with conical warts about 7 to 8 μ high.	"Crenate"	Densely clothed with strong conical spines about 11 to 12 μ high.	Densely clothed with strong conical spines about 11 μ high.	Densely covered with conical spines about 3.5 to 5.5 μ high.
Spore, diameter	Exclusive of warts, 48 μ		Exclusive of spines, 44 μ.	Exclusive of spines, 36 to 42 μ.	Exclusive of spines, about 34 μ.
Androgonidia	Usually 5, more or less	50 to 100 in each male coenobium.	Several hundreds in each male coenobium.	Few	Few.
Antheridia	Sperm platelets or globoids.	Flattened sperm globoids.	Sperm platelets?	Sperm globoids	Sperm globoids.
Antheridia and oogonia	Usually in the same coenobia.	In different coenobia	In different coenobia	In the same coenobium	In the same coenobium.

pole in more mature coenobia. A sketch from living material of *V. barberi* was made on July 31, 1914, and is reproduced herewith as text fig. 5. This represents an optical section view of the coenobium wall of a nearly mature asexual specimen. The pear-shaped protoplasts are more especially characteristic of the hinder parts of the coenobia. In the forward parts the protoplasts are ovoid.

The following key to the species of *Volvox* is offered in the absence of data that would be necessary for the construction of a key based entirely on vegetative or asexual characters.

Key to the species of Volvox.

1. Oospore walls angularly wavy ..... V. globator.
1. Oospore walls crenate ..... V. perglobator.
1. Oospore walls spinose ..... 2.
2. Sexual coenobia dioecious ..... V. rousseleti.
2. Sexual coenobia monoecious ..... 3.
3. Somatic protoplasts large and broad ..... V. merrilli.
3. Somatic protoplasts small and narrow ..... V. barberi.

A form of *Volvox* described by Carter ('59) at Bombay, India, was identified by him with *Volvox stellatus* Ehrenberg, a species reduced by all European workers to *V. globator*. This form is most nearly like the two Philippine species. Though the descriptive data furnished by Carter are insufficient to enable one with certainty to assign the form to one or the other of the species, the evidence is rather in favor of considering it to be *V. barberi*.

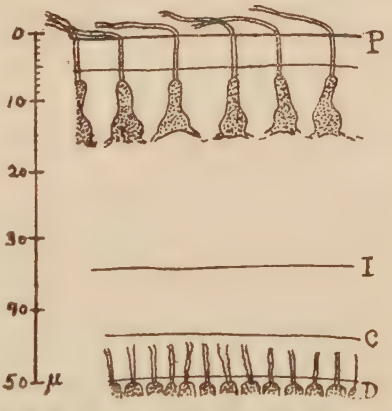

FIG. 5. *Volvox barberi* sp. nov. Coenobium wall of a nearly mature asexual coenobium, in optical section from a living specimen, showing protoplasts and the visible limits of the membranes.

SPECIES EXCLUDED FROM VOLVOX

Species that have been described under the name of *Volvox* and that are to be left out of this genus and assigned to other genera are: *Volvox carteri* Stein ('78), for which *V. weismannia* Powers ('08) is another name, *V. tertia* Meyer ('96), and *V. africana* West ('10), all of which are characterized by having rounded protoplasts without connecting filaments

and by having large gonidia that are differentiated early; and *V. spermatosphaera* Powers ('07 and '08) in which the differentiation of the gonidia is not so early. Another, described as a "second form of *Volvox*" by Powers ('07), has received the generic name *Besseyosphaera* (Shaw, '16).

A satisfactory treatment of the two Philippine species of *Volvox,* based on a more extended study of both living and preserved material from various localities, has been most greatly interfered with by the presence in the same habitat of a number of other species of large Volvocaceae presenting novel features that insistently claimed attention.

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ILLUSTRATIONS

[Photomicrographs of *Volvox* species, from specimens mounted in glycerine, taken by W. R. Shaw and E. Cortes at the Bureau of Science, Manila.]

PLATE 1. VOLVOX MERRILLI SP. NOV.

FIG. 1. The type specimen, a sexual coenobium with ninety-two nearly ripe oospores. × 100.

2. A portion of the surface of the same coenobium showing the somatic cells. × 400.

3. Oospores below the surface of the same part of the coenobium that is shown in the preceding figure. × 400.

PLATE 2. VOLVOX MERRILLI SP. NOV.

FIG. 4. Another view of the same oospores with the shadows of the overlying somatic cells not so dark and the spines shown with less depth of focus. × 400.

5. Oospores in another coenobium of the same species. One is smaller than the typical spores, and resembles those of the other species. ×400.

PLATE 3. FIGS. 6 TO 11, VOLVOX MERRILLI SP. NOV.; FIG. 12, VOLVOX BARBERI SP. NOV.

FIG. 6. A young sexual coenobium showing three or four antheridia in different stages of formation. × 100.

7. A small asexual coenobium with only two embryo daughters. × 100.

8. A small coenobium with eight reproductive bodies, probably gonidia. × 100.

9. A sexual coenobium a little older than that of fig. 6, showing three or four antheridia in different stages of development, and numerous oogonidia that are a little larger than the somatic cells. × 100.

10. A very small coenobium with three reproductive bodies that are gonidia and have each divided into eight cells. × 100.

11. A half-grown asexual coenobium containing seven embryo daughters. × 100.

12. A very small coenobium without reproductive bodies. × 100.

PLATE 4. VOLVOX BARBERI SP. NOV.

FIG. 13. The type specimen; a sexual coenobium with two hundred twenty-four nearly ripe oospores. ×100.

14. A portion of the same coenobium showing in the middle the nearly ripe oospores, and in other parts somatic cells that are in focus because of the bent state of the coenobium wall. × 400.

PLATE 5. VOLVOX BARBERI SP. NOV.

FIG. 15. A nearly mature asexual coenobium with eight daughters that have developed cilia. × 100.

16. An asexual coenobium with four daughters that are beginning to develop cilia. ×100.

17. An asexual coenobium with six daughters that have begun to develop cilia. × 100.

TEXT FIGURES

FIG. 1. *Janetosphaera aurea* (*Volvox aureus*). Diagram of cells and membranes as seen in surface view. After Meyer.

2. *Janetosphaera aurea* (*Volvox aureus*). Diagram of cells and membranes as seen in cross section of coenobium. After Meyer.

3. *Volvox globator.* Diagram of cell membranes as seen in a cross-section view of a portion of the coenobium wall. After Meyer.

4. *Volvox globator.* Diagram of cell membranes as seen in surface view and tangential sections of the coenobium wall. After Meyer.

5. *Volovox barberi* sp. nov. Coenobium wall of a nearly mature asexual coenobium, in optical section from a living specimen, showing protoplasts and the visible limits of the membranes.

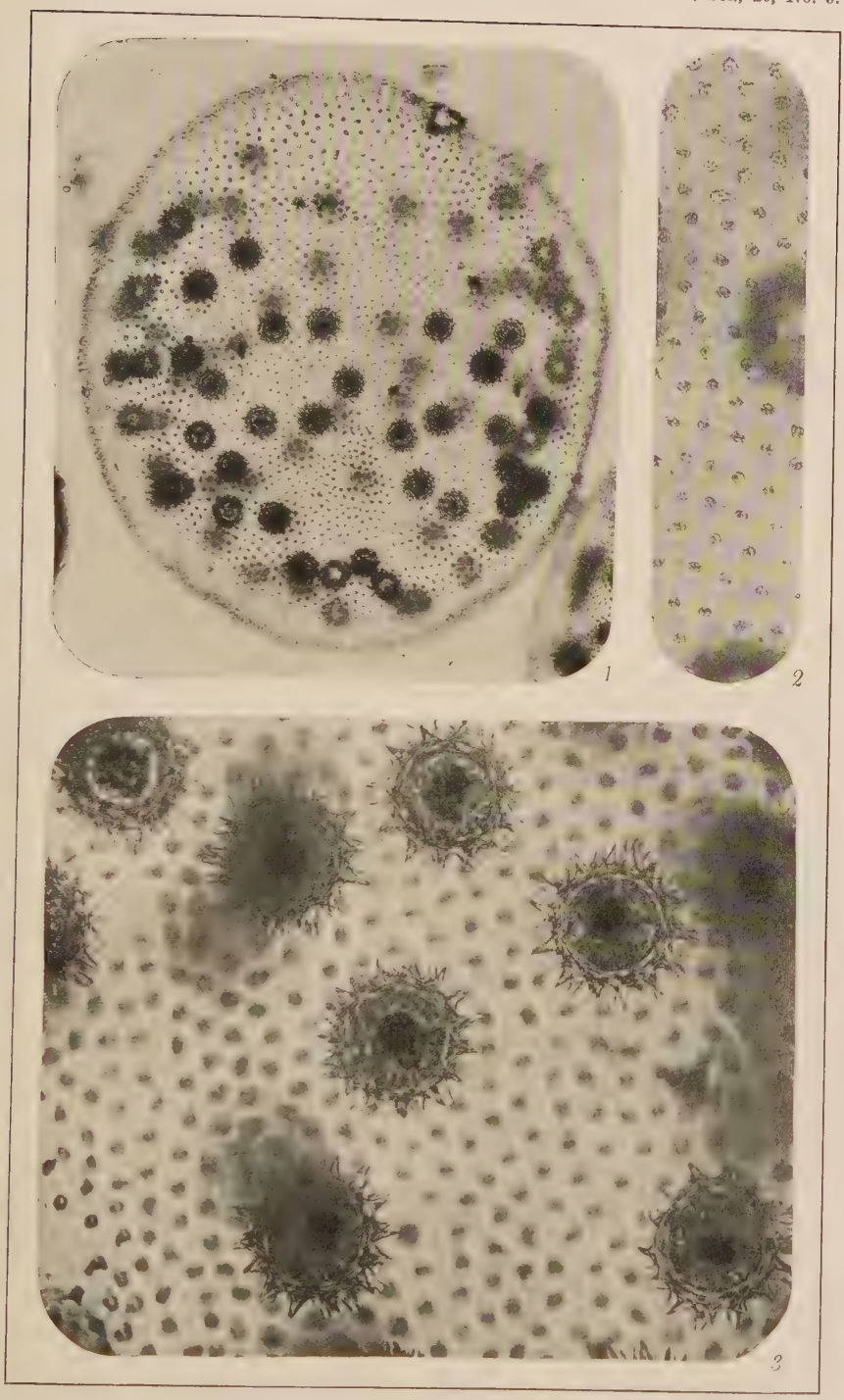

PLATE 1. VOLVOX MERRILLI SP. NOV.

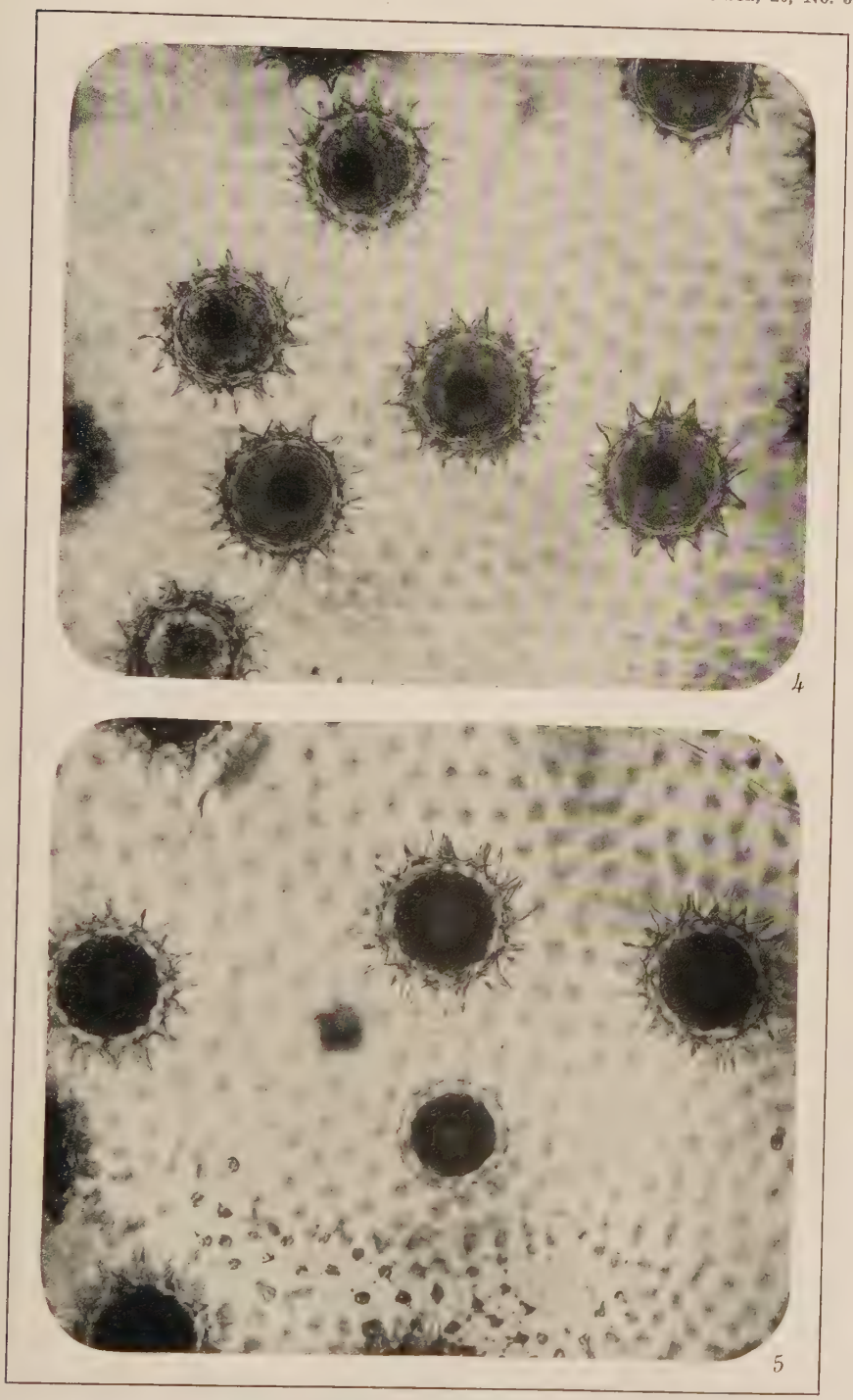

PLATE 2. VOLVOX MERRILLI SP. NOV.

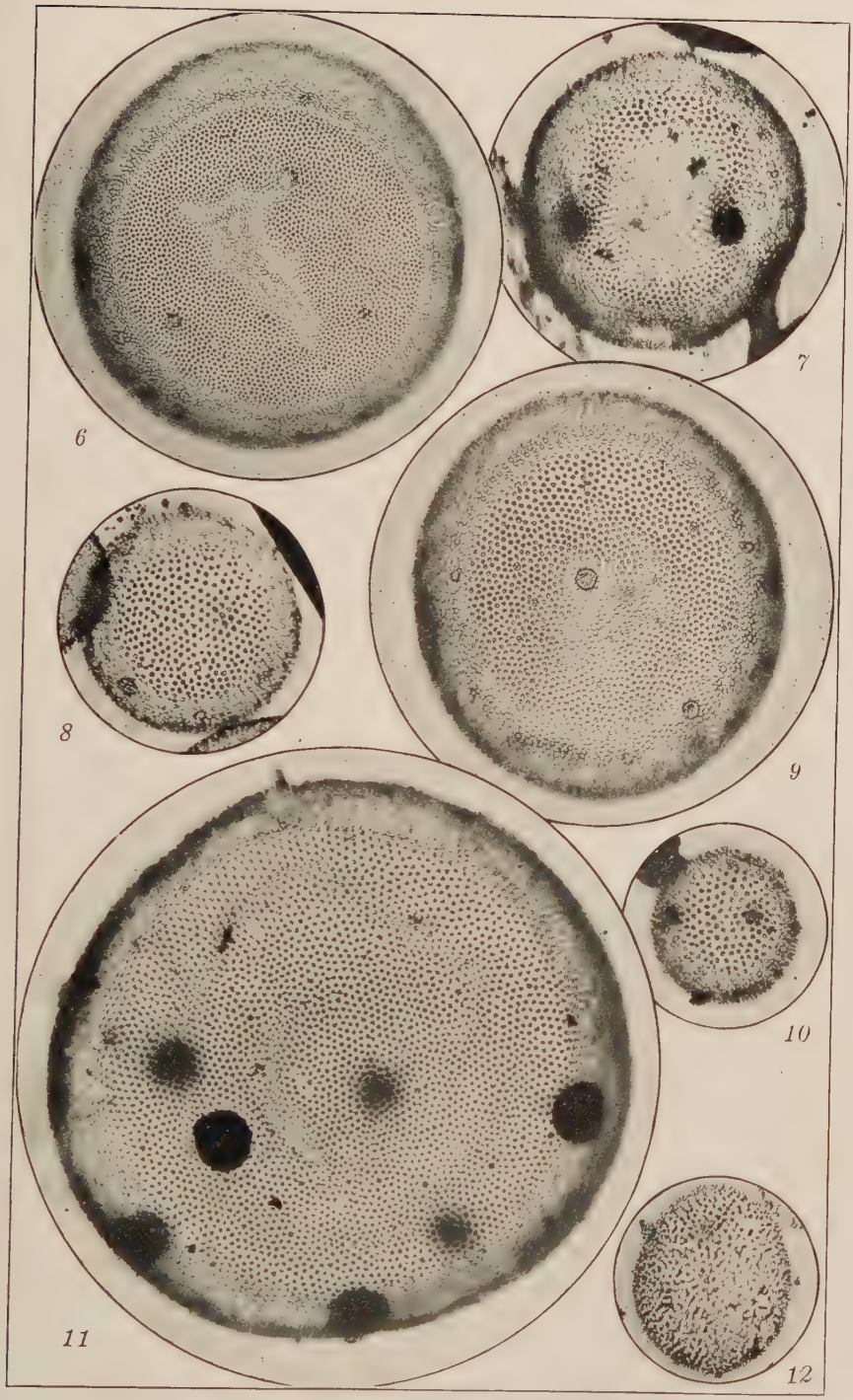

PLATE 3. VOLVOX MERRILLI AND V. BARBERI SPP. NOV.

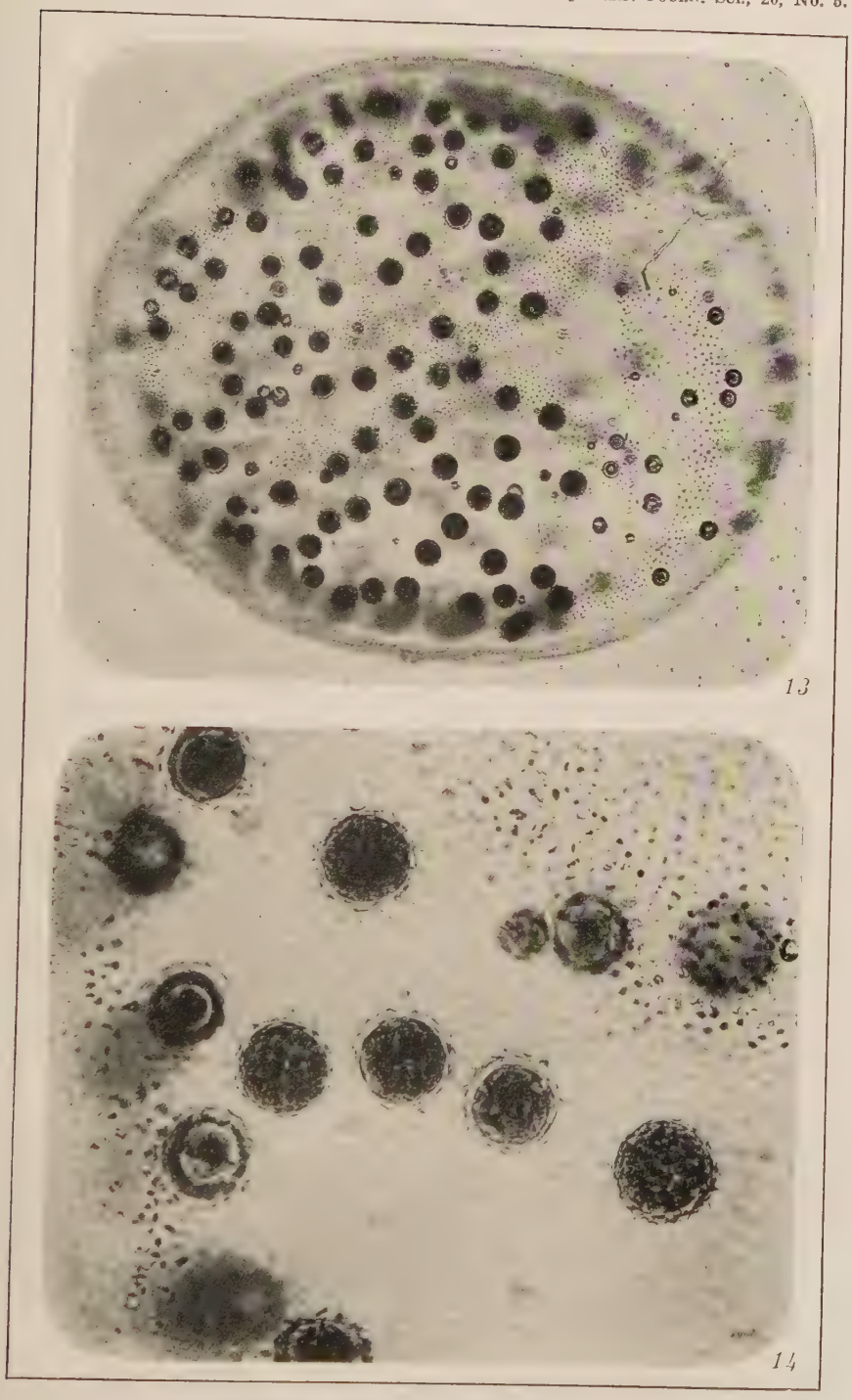

PLATE 4. VOLVOX BARBERI SP. NOV.

PLATE 5. VOLVOX BARBERI SP. NOV.

EXTRACTION OF COPRA CAKE WITH SOLVENTS

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and

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INTRODUCTION

In recent years the demand and prices for animal fats, such as lard and butter, have been steadily increasing. The animal industries of the world, while capable of more extensive development, seem hardly able to provide the abundant supplies of butter and lard which will be desired in the future and it appears that there will probably be a permanent shortage of animal fats. This has led to a greatly increased use of vegetable fats by European and American makers of artificial butter, resulting in an unusual demand for these vegetable products. The hydrogenation process, by which vegetable oils are converted to hard solid fats which can be substituted for animal fats, has also given an impetus to the development of the vegetable-oil industries. Since coconut oil is one of the most popular ingredients of artificial butters and edible fats these trade conditions in vegetable fats have naturally affected the Philippines, which is one of the largest coconut-producing countries in the world.

Formerly, a large proportion of Philippine coconuts was converted into copra, which was shipped to the United States and to European countries where the oil was expressed. When copra is allowed to stand for a considerable length of time before shipment it tends to deteriorate, causing a loss in the quality and quantity of the oil. Obviously, in so far as this deterioration is concerned, it is more economical to produce oil in the countries where the coconuts are grown. This would logically reduce the bulk of the shipments and avoid possible losses due to spoiling. The shortage of shipping space during the world war naturally made it even more advisable to express the oil

near the source of coconut production. The result of these various conditions has been the establishment of a considerable number of oil mills in the Philippines. The increase in the coconut-oil business in the Philippines is shown very clearly in Table 1, which gives the exports of copra and coconut oil from 1913 to 1920.

TABLE 1.—*Amount and value of copra and coconut oil exported from the Philippines from 1913 to 1920* [a]

Year.	Copra.		Coconut oil.	
	Amount.	Value.	Amount.	Value.
	Kilograms.	*Pesos.*	*Kilograms.*	*Pesos.*
1913	82,219,363	19,091,448	5,010,429	2,292,678
1914	87,344,695	15,960,540	11,943,329	5,238,366
1915	139,092,902	22,223,109	13,464,169	5,641,003
1916	72,277,164	14,231,941	16,091,169	7,851,469
1917	92,180,326	16,654,301	45,198,415	22,818,294
1918	55,061,736	10,377,029	115,280,847	63,328,317
1919	25,094,027	8,839,376	139,942,612	73,719,504
1920	25,803,044	7,433,741	77,571,405	46,537,773

[a] Annual Report, Insular Collector of Customs, Manila (1920).

The two commercial methods employed to obtain coconut oil from copra, which is the dried meat of the coconut, are the pressure (expeller and hydraulic) and the extraction processes. In the pressure process, the copra is ground, heated, and subjected to pressure. The expeller oil cake which remains after the first expression still contains a considerable quantity of oil (about 10 to 15 per cent) and is subjected to a second expression by means of hydraulic presses after which the hydraulic cake contains only a small percentage of oil (about 4 to 7 per cent). The coconut oil thus obtained is filtered and stored in large tanks, ready for domestic use or export. The oil cake (copra cake) which remains after the oil has been expressed is used as cattle food or, sometimes, as fertilizer or fuel. In the extraction process the dried copra is ground sufficiently fine to break the oil cells as much as possible. The material is then treated with some volatile solvent such as benzene or carbon tetrachloride. The solvent containing the dissolved oil is drawn off from the extracted residue (pomace) and filtered. The oil is then separated from the solvent by distillation, after which the solvent is returned to storage and used for subsequent extractions. Solvent-extraction plants have been operating in Germany and England for some years, and several plants are now

in operation in the United States where they are extracting various oil seeds and oil cakes, such as coconut, cottonseed, corn, castor beans, palm kernels, etc. Of the solvents which have been tried Shrader [1] states that benzene and trichlor ethylene appear to give the best results. In the Philippines all companies, with one exception, use the pressure process. Recently an extraction plant was built, but we have been unable to obtain any data concerning its products.

One of the principal duties of the oil chemist in a coconut-oil mill is to determine the amount of oil remaining in the copra cake, and usually many analyses are made during the day. The standard method employed for this purpose is to extract the copra cake with ether, using the well-known Soxhlet apparatus. Since ether is a very volatile and inflammable liquid and somewhat troublesome to handle in an oil-mill laboratory in a warm tropical country, it was thought that possibly some other, more suitable solvent might be used in place of ether.

The object of the present investigation is to determine the comparative results obtained by extracting copra cake with various solvents.

SAMPLE

The samples of copra cake used in this investigation were obtained from one of the largest coconut-oil mills in Manila. We used average samples of both expeller and hydraulic cakes. The cakes were broken up into rather fine pieces and quartered twice after which they were powdered in mortars and sieved until sufficiently fine for the entire sample to pass a 50-mesh screen. The powdered sample was then heated in an air bath about ten minutes at 80°. Analysis of these cakes gave the results recorded in Table 2.

TABLE 2.—*Analyses of copra cake.*[a]

Constants.	Expeller cake.	Hydraulic cake.
	Per cent.	*Per cent.*
Ash	4.76	7.51
Crude fiber	6.84	7.47
Protein (N × 6.25)	20.94	20.71
Moisture	3.40	7.29
Free fatty acids (as oleic)	5.05	5.28

[a] Analyses made by F. Agcaoili and W. Salvador, Bureau of Science.

[1] Shrader, J. H., Chem. Met. Eng. 25 (1921) 94.

PROCEDURE

The solvents used in this investigation to extract coconut oil from copra cake were ether, carbon tetrachloride, benzene, petroleum ether, chloroform, acetone, absolute alcohol, alcohol (95 per cent), and methyl alcohol. Preliminary experiments showed that coconut oil dissolves readily in these various substances. The solvents were purified by special means when necessary and distilled several times until they showed a constant boiling point. In working with these solvents we employed the usual Soxhlet extractors. Two electric heaters containing six extractors each were used. Since the boiling point of the solvents varied from 34 ° to 80 ° the electric heater employed for the higher-boiling solvents was arranged to give a somewhat higher temperature than the other heater used for the lower-boiling solvents. The extraction temperature was regulated so that the rate of extraction was approximately the same for each solvent and for each interval of time. Although the various solvents boil at different temperatures, by placing pieces of asbestos under the extraction flasks the heat can be regulated so that each solvent will require approximately the same length of time (about twenty-four minutes) to syphon. When the extraction was completed for a definite interval of time the heating was continued until most of the solvent had distilled into the upper part of the apparatus and was just about ready to syphon. The heating was then discontinued. The extraction flask which still contained a small amount of solvent was disconnected and placed in an electric oven heated to a temperature of about 75°. The flask containing the extracted residue was allowed to remain in the oven until all the solvent had apparently evaporated, after which it was weighed. The flask was again heated and weighed several times until a constant weight was obtained. Since ether is the solvent that is commonly employed to extract oil from copra cake, we used the results obtained with ether as a standard for comparison.

In all our extraction experiments we used a 2-gram sample of material, and the experiments were always performed in duplicate. The duplicate extractions for each interval were naturally carried out with fresh samples of copra cake. In some cases, when the results of our duplicates did not agree very closely, we performed several series of duplicate experiments until we obtained fairly constant results.

In many series of experiments we varied the intervals of time for a particular solvent from three to thirty-six hours.

In these experiments the material was exposed to the solvent for a longer period of time than is customary in technical analysis, which requires usually only twelve hours.

RESULTS

The average results obtained by extracting expeller copra cake with different solvents are recorded in Table 3. These figures give a fairly accurate idea as to the relative extractive power of the solvents with copra cake.

TABLE 3.—*Extraction of expeller copra cake with solvents.*

Solvent.	Extraction.					
	3 hours.	6 hours.	8 hours.	10 hours.	24 hours.	36 hours.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ether	13.38	13.49	13.58	13.69	13.80	13.90
Carbon tetrachloride	13.28	13.55	13.56	13.32	13.45	13.58
Benzene	13.29	13.50	13.67	13.85	13.93	14.42
Petroleum ether (40° to 55°)	13.36	14.34			15.10	
Chloroform	14.22	15.04	15.28	15.32	15.40	15.46
Acetone	15.43	15.80	16.13	16.39	17.04	18.19
Ethyl alcohol (absolute)	24.74	26.55	28.12	29.05	31.51	33.90
Ethyl alcohol (95 per cent)	27.27	29.18	30.52	31.85	32.87	34.05
Methyl alcohol	30.36	32.66	33.35	33.80	34.40	35.47

Copra cake contains not only coconut oil but also other substances, such as crude fiber, protein, and small amounts of nonfatty substances. In extracting copra cake with different solvents we would naturally expect some of the solvents to give a greater percentage of extraction than others, because the nonoleaginous material in the copra cake is likely to be more soluble in some solvents than in others,

The figures given in Table 3 show that the percentage of extraction is approximately the same for ether, carbon tetrachloride, and benzene. Chloroform and acetone give a somewhat higher percentage while the alcohols give a very high percentage, especially methyl alcohol, which gives over 30 per cent for a three-hour period. Petroleum ether gives about the same result as ether for a three-hour period, but for longer periods the extraction is somewhat greater.

These results would seem to indicate that ether, carbon tetrachloride, and benzene dissolve less of the nonfatty substances than do the other solvents and should give more accurate results than chloroform, acetone, and petroleum ether which

probably dissolve a small quantity of those substances, and the alcohols which no doubt dissolve a considerable quantity.

With the exception of carbon tetrachloride, the figures showing the percentage extraction with the various solvents increase gradually with the time interval. With ether the increase is very gradual. Benzene, petroleum ether, and chloroform show a slightly greater increase, while acetone and the alcohols show a rather large increase. Absolute alcohol shows the greatest increase. Methyl alcohol gives a greater percentage extraction than any of the other solvents.

As carbon tetrachloride and benzene give about the same results as ether, our experiments would seem to indicate that either of these solvents could ordinarily be used in place of ether; and, if desired, the results could be calculated to the ether standard. These solvents are more easily handled in a tropical climate than ether, since they boil at a much higher temperature, and carbon tetrachloride also has the advantage that it is not inflammable.

Shrader [2] gives figures showing the speed of evaporation of various solvents. The data were obtained by allowing 5 cubic centimeters of various solvents to evaporate from an alberene dish under similar conditions. The results showed that ether evaporates in 2 minutes, carbon tetrachloride in 11.5 minutes, and benzene in 12.5 minutes. In so far as evaporation is concerned, carbon tetrachloride and benzene would evidently be very desirable solvents for routine work in the Tropics.

The figures (Table 3) showing the percentage extraction with carbon tetrachloride increase up to a period of six hours, after which there appears to be no further extraction. These results indicate that carbon tetrachloride probably dissolves less of the nonfatty substances in the copra cake than any of the other solvents and since carbon tetrachloride requires less time for extraction it would appear to be a very suitable solvent.

HYDRAULIC CAKE

In addition to our work on expeller cake we also carried out a few experiments on the extraction of hydraulic cake (Soxhlet method) with different solvents for a six-hour period only. The results are recorded in Table 4, which gives also, for purposes of comparison, the figures previously given in Table 3, showing the extraction of expeller cake for a six-hour period.

[2] Shrader, J. H., Chem. Met. Eng. 25 (1921) 99.

TABLE 4.—*Extraction of expeller and hydraulic copra cakes with solvents.*

[Six-hour period; Soxhlet method.]

Solvents.	Expeller cake.	Hydraulic cake.
	Per cent.	*Per cent.*
Ether	13.50	7.00
Carbon tetrachloride	13.56	7.27
Benzene	13.50	7.19
Chloroform	15.04	9.04
Acetone	15.80	10.17
Ethyl alcohol (absolute)	26.55	22.25
Ethyl alcohol (95 per cent)	29.18	25.36
Methyl alcohol	32.66	27.91

As shown by the figures in Table 4, ether, carbon tetrachloride, and benzene give about 7 per cent extraction with hydraulic cake and about 13.5 per cent with expeller cake. For both the expeller and the hydraulic cakes the percentage extraction with acetone is slightly higher than with chloroform, while with the alcohols there is a considerable increase. The figures given in Table 4 indicate that the extraction of expeller and hydraulic cakes with the same solvents give similar results.

NONFATTY MATERIAL IN COPRA CAKE

As previously stated copra cake contains not only coconut oil but also other substances, such as crude fiber, protein, and nonfatty material. The figures given in Tables 3 and 4 show that the percentage extraction with methyl alcohol is considerably greater than with carbon tetrachloride, which indicates that methyl alcohol dissolves not only the oil from copra cake but also a considerable quantity of nonfatty material. The nonfatty material may, therefore, be obtained by first treating the copra cake with carbon tetrachloride which dissolves out the oil and then extracting the oil-free cake with methyl alcohol.

As we thought that data on the nonfatty material might, perhaps, be of some interest we carried out these experiments. The extraction with carbon tetrachloride was made with the Soxhlet apparatus, using 10-gram samples and extracting about eight hours. Each sample was then filtered and dried, after which it was extracted with methyl alcohol. The extractions with methyl alcohol were combined, filtered, and most of the alcohol eliminated by distillation. The small quantity of alcohol remaining in the residue was then distilled out with partial vacuum. The nonfatty material was very thick and sticky and

had a dark color like molasses. It also had a somewhat sweet, acid odor. Analysis gave the results recorded in Table 5.

TABLE 5.—*Analysis of nonfatty material in expeller copra cake.*[a]

Acid value	49
Saponification value	145
Iodine value	6.61
Nitrogen (per cent)	1.26
Reducing sugars (per cent)	13.16

[a] Analysis made by B. Nelson, Bureau of Science.

The results given in Table 5 show that the nonfatty material contains 1.26 per cent nitrogen, which calculated as protein (N × 6.25) would give 7.87 per cent.

Referring to alcohol-soluble proteins Osbourne [3] says that these alcoholic solutions can be concentrated to thick sirups from which the proteins may be obtained and that some proteins, zein and gliadin for instance, not only dissolve in ethyl alcohol but in other alcohols like methyl and propyl.

If the nitrogen in the nonfatty material is present as protein this is rather remarkable, since Osbourne states that proteins soluble in alcohol have been found only in the seeds of cereals and not in any other seed and in this respect these proteins show a marked contrast in their solubility to all other proteins of animal or vegetable origin.

Santos [4] carried out experiments on copra cake to determine the amount of proteins soluble in different solvents, and his results showed that with ethyl alcohol there is practically no alcohol-soluble protein. Since the extraction of copra cake with methyl alcohol gives a result which is only slightly higher than with ethyl alcohol (Tables 3 and 4), it would seem that copra cake probably contains no proteins which are soluble in either ethyl or methyl alcohol. Since the nonfatty material showed a high acid content (Table 5), possibly the nitrogen is in the form of amino acids or perhaps a slight proportion is present as protein (prolamins) and the remainder as amino acids.

As practically our entire sample was required for analysis, we were unable to continue further our investigation on the nonfatty material in copra cake. It might be interesting to isolate the acids from the nonfatty material and endeavor to identify them and ascertain what proportion, if any, are amino acids. A more thorough investigation of this material may,

[3] Osbourne, T. B., Vegetable Proteins (1919) 20, 32, and 34.
[4] Santos y Alvarez, F. O., Philip. Journ. Sci. 16 (1920) 186.

perhaps, give some very interesting results, and we expect to continue this work when time permits.

SUMMARY

The extraction of expeller copra cake with different solvents has been studied for various intervals of time. The results show that ether, carbon tetrachloride, and benzene give approximately the same percentage extraction. It appears, therefore, that either carbon tetrachloride or benzene could be used for the routine estimation of the oil remaining in copra cake.

Chloroform, acetone, and petroleum ether appear to dissolve not only oil but also small quantities of nonfatty substances from expeller copra cake while ethyl and methyl alcohols dissolve a considerable quantity. These solvents would, therefore, be undesirable for routine analysis showing the percentage of oil extracted from copra cake.

The extraction of hydraulic cake with different solvents gave results similar to those obtained with expeller cake.

By extracting expeller copra cake with carbon tetrachloride and afterwards extracting the oil-free cake with methyl alcohol the nonfatty material was obtained. Analysis of the nonfatty material showed that it had a high acid and saponification value and also contained a small percentage of nitrogen. The nitrogen may, perhaps, be present as amino acids or possibly a small portion of it as protein.

ALCYONARIEN VON DEN PHILIPPINEN

I. DIE GATTUNG ALCYONIUM LINNÆUS [1]

Von H. Lüttschwager

EINE TAFEL UND FÜNF TEXTFIGUREN

Das mir von Herrn Professor Kükenthal zur Bearbeitung anvertraute Material von den Philippinen enthält von der Gattung *Alcyonium* nur Vertreter der Untergattung *Eualcyonium* Broch, während von den beiden andern Untergattungen *Metalcyonium* und *Erythropodium* keine Exemplare vorliegen.

Nachdem ich bereits früher in meinen Beiträgen [2] die älteren Arten der Gattung kritisch untersucht habe, konnte ich an der Hand eines reichen mir vorliegenden Materials in eine umfassendere Prüfung der einzelnen Arten eintreten, und erkenne nunmehr 19 sichere Arten als zu *Eualcyonium* gehörig an, zu denen noch 5 unsichere Arten treten.

[1] This is the first of a series of four papers on Philippine Alcyonaria of the family Alcyoniidæ. These papers were prepared under the supervision of Dr. Willy Kükenthal, director of the Zoölogical Museum, Berlin, and the world's greatest authority on the classification of the Alcyonaria. They are particularly important in that they deal with forms found everywhere in the Islands on shallow reefs and banks. With the Notes on Philippine Alcyonaria, by Prof. S. F. Light, of the University of the Philippines, they give us an excellent start toward a knowledge of our rich littoral alcyonarian fauna. The keys to species, which make these papers particularly useful, are given in English as well as in German for the convenience of those not familiar with the latter language. As time permits, it is planned to treat other genera in a somewhat similar manner.

The Philippine material treated in these papers is from the zoölogical collection of the department of zoölogy, College of Liberal Arts, University of the Philippines. It was collected for the most part by S. F. Light on the joint expeditions of the University of the Philippines and the Bureau of Science to Port Galera, on the northeast coast of Mindoro, in 1912, and to Taytay, on the east coast of Palawan, in 1913. A few of the specimens were collected by Dr. L. E. Griffin and Prof. L. D. Wharton in the Bantayan Islands, near Cebu Island.—The Editors.

[2] Beiträge zu einer Revision der Familie Alcyoniidae, Arch. f. Naturgeschichte Abt. A, Heft 10 (1914).

Zu *Eualcyonium* gehören folgende Arten:

Alcyonium digitatum Linn.
Alcyonium compressum Th. Stud.
Alcyonium glomeratum Hassal.
Alcyonium palmatum Pallas.
Alcyonium brioniense Kükth.
Alcyonium adriaticum Kükth.
Alcyonium pachyclados Klzgr.
Alcyonium brachyclados (Ehrbg.)
Alcyonium sphaerophorum (Ehrbg.)
Alcyonium sphaerophorum var. *sansibaricum* Cohn.
Alcyonium globuliferum Klzgr.
Alcyonium digitulatum Klzgr.
Alcyonium ceylonense May.
Alcyonium etheridgei Thoms. u. Mack.
Alcyonium paessleri May.
Alcyonium equisetiforme n. n. = *paessleri* Hickson.
Alcyonium fallax n. n. = *purpureum* Hickson.
Alcyonium valdiviae Kükth.
Alcyonium fauri Thoms.
Alcyonium gracillimum Kükth.

SPECIES DUBIAE

Alcyonium rotiferum Thoms.
Alcyonium bradleyi Verrill.
Alcyonium stellatum M. Edw.
Alcyonium laciniosum Esp.
Alcyonium molle (*stellatum*) Esp.

Zunächst will ich eine Bestimmungstabelle aller sicheren Arten geben.

Bestimmungstabelle. Untergattung Eualcyonium.

Mit wenig gelappten oder plump verästelten Stöcken.

1. Die Coenenchymspicula sind dünne Spindeln und Stäbe oder besitzen unregelmässige Gestalt und bilden Vierer und Achter ..... 2.
   Die Coenenchymspicula sind Hanteln oder mit einer Einschnürung versehene hantelähnliche Gebilde ..... 6.
   Die Coenenchymspicula sind dicke, stark bewarzte Spindeln.
   A. gracillimum Kükth.
2. Die Kolonie besteht aus einem schlanken sterilen Stiel und einer Anzahl dünner Aeste ..... 3.
   Die Kolonie besteht aus kurzen, dicken, fleischigen Aesten ..... 4.
3. Die Kolonie ist durchscheinend, die Polypen sind gross, hyalin.
   A. palmatum Pallas.
   Die Kolonie ist wenig durchsichtig, die Polypen sind gross.
   A. adriaticum Kükth.
   Die Kolonie ist undurchsichtig, die Polypen sind klein, gelb.
   A. brioniense Kükth.
4. Die Aeste sind nach oben zugespitzt und schlank.. **A. glomeratum** Hassal.
   Die Aeste sind oben nur abgerundet, bleiben aber plump und dick..... 5.
5. Die Polypen sind intensiv rot ..... **A. compressum** Stud.
   Die Polypen sind heller, ganz hyalin ..... **A. digitatum** Linn.
6. Die Coenenchymspicula sind typische Hanteln. Die Rindenspicula sind stets anders geformt als die Coenenchymspicula and sind keine Keulen ..... 7.
   Die Coenenchymspicula sind keine typischen Hanteln, sondern Doppel-Walzen, -kugeln, auch scheibenförmig. Die Rindenspicula sind, wenn vorhanden, auch Keulen ..... 11.

7. Die Rindenspicula sind biskuitartige Gebilde ..... 8.
   Die Rindenspicula sind durch kurzen Hals verbundene Doppelkugeln.
   A. globuliferum Klzgr.
8. Die Zweige der Kolonie sind klein und rund ..... 9.
   Die Zweige der Kolonie sind gross, fingerförmig ..... 10.
9. Die Zweige stehen sehr dicht, platten sich gegenseitig ab, und die Kolonie erscheint gehirnartig ..... **A. sphaerophorum** (Ehrbg.).
   Die Zweige sind etwas höher und stehen lockerer .. **A. digitulatum** Klzgr.
10. Die Coenenchymspicula haben einen kurzen dicken Hals.
    A. pachyclados Klzgr.
    Die Coenenchymspicula haben einen langen Hals mit wenigen Dornen an jedem Ende ..... **A. brachyclados** (Ehrbg.).
11. Im Coenenchym liegen neben anderen Spicula auch einfache Keulen .. 12.
    Im Coenenchym liegen keine Keulen ..... 15.
12. Die Kolonie besitzt einen deutlichen Stiel.
    A. etheridgei Thoms. und Mack.
    Die Kolonie besitzt keinen deutlichen Stiel ..... 13.
13. Die Coenenchymspicula sind neben Keulen auch Doppelkugeln mit schwacher Einschnürung ..... 14.
    Die Coenenchymspicula sind nur Doppelkeulen oder Hanteln mit starker Einschnürung, die Rindenspicula sind keulenförmig.
    A. ceylonense May.
14. Im Coenenchym liegen auch bedornte Spindeln ..... **A. paessleri** May.
    Im Coenenchym liegen keine Spindeln ..... **A. fallax** n. n.
15. Die Spicula sind walzenförmig mit schwacher Einschnürung und schwacher Bedornung ..... **A. equisetiforme** n. n.
    Die Spicula sind scheibenähnlich oder bewarzte Ovale ..... 16.
16. Die scheibenähnlichen Spicula sind mit schwachen Warzen besetzt.
    A. fauri Thoms.
    Die scheibenähnlichen Spicula sind stark bewarzt .... **A. valdiviae Kükth.**

Key to species of the subgenus Eualcyonium.

With sparsely lobed or bluntly branched stalks.

1. The coenenchyma spicules are slender spindles and rods or have an irregular shape, four- or eight-parted ..... 2.
   The coenenchyma spicules are dumb-bell-shaped or with a constriction giving them a dumb-bell-like form ..... 6.
   The coenenchyma spicules are thick, strongly warted spindles.
   A. gracillimum Kükth.
2. The colony consists of a slender, sterile stalk with a number of slender branches ..... 3.
   The colony consists of short, thick fleshy branches ..... 4.
3. The colony is translucent, the polyps large and hyaline.
   A. palmatum Pallas.
   The colony is slightly transparent, the polyps large .. **A. adriaticum** Kükth.
   The colony is not transparent, the polyps are small, yellow.
   A. brioniense Kükth.
4. The branches are pointed distally and slender .... **A. glomeratum** Hassal.
   The branches are rounded distally, blunt and thick ..... 5.
5. The polyps are deep red ..... **A. compressum** Stud.
   The polyps are light, hyaline ..... **A. digitatum** Linn.

6. The coenenchyma spicules are typically dumb-bell-shaped. The rind spicules always differ in form from the coenenchyma spicules and are never club-shaped ..... 7.
   The coenenchyma spicules include no typical dumb-bell-shaped forms, but double cylinders, spheres or disks. The rind spicules, if present, include also clubs ..... 11.
7. The rind spicules have a biscuit-like form ..... 8.
   The rind spicules are double spheres with short necks ..... **A. globuliferum** Klzgr.
8. The twigs of the colony are small and round ..... 9.
   The twigs of the colony are large and fingerlike ..... 10.
9. The twigs are close-set, flattened against one another and the colony has a brainlike appearance ..... **A. sphaerophorum** (Ehrbg.).
   The twigs are somewhat higher and stand somewhat farther apart. **A. digitulatum** Klzgr.
10. The coenenchyma spicules have a short thick neck. **A. pachyclados** Klzgr.
    The coenenchyma spicules have a long neck and small thorns on either end ..... **A. brachyclados** (Ehrbg.).
11. Besides other spicules in the coenenchyma there are simple clubs .... 12.
    No clubs in the coenenchyma ..... 15.
12. The colony has a distinct stalk ..... **A. etheridgei** Thoms. and Mack.
    The colony has no distinct stalk ..... 13.
13. The coenenchyma spicules are, in addition to clubs, double spheres with slight constrictions ..... 14.
    The coenenchyma spicules consist only of double spheres or dumb-bell-like forms with deep constrictions. The rind spicules are club-shaped ..... **A. ceylonense** May.
14. The coenenchyma spicules include thorned spindles .... **A. paessleri** May.
    The coenenchyma spicules include no spindles ..... **A. fallax** n. n.
15. The spicules are cylindrical with weak constrictions and slightly thorned ..... **A. equisetiforme** n. n.
    The spicules are disklike or warted ovals ..... 16.
16. The disklike spicules are beset with inconspicuous warts. **A. fauri** Thoms.
    The disklike spicules are strongly warted ..... **A. valdiviae** Kükth.

In der mir vorliegenden Ausbeute von den Philippinen fanden sich Exemplare folgender 3 Arten vor: *Alcyonium pachyclados* Klzgr., *A. digitulatum* Klzgr.; und *A. equisetiforme* n. n., deren Beschreibung ich anbei folgen lasse.

Alcyonium pachyclados Klunzinger. Tafel 1, Fig. 1.

Alcyonium pachyclados KLUNZINGER, Korallt. d. Rot. Meer. 1 (1877) 24, t. l. f. 5; MAY, Jena. Z. 33 (1899) 106, t. l, f. 13; I. L. HILES, Stolonifera and Alcyonacea, Willey, Zool. Results pt. 4 (1900) 503; HICKSON, Alcyonaria and Hydrocorallia of the Cape of Good Hope (1900) 72; PRATT, Alcyonaria of the Maldives, pt. 2 (1903) 534; Rep. Pearl Oyster Fisheries Manaar 19 (1905) 258; THOMSON und HENDERSON, Alcyonarians from Sansibar (1906) 416; COHN, Alcyonarien von Madagask. u. Ostafrika 2 (1908) 235;

Kükenthal, Fauna S. W. Austral. 3 (1910) 430; Thomson, Trans. Soc. of Edinburg pt. 3 47 (1910) 570, t. 2, f. 14, t. 4, f. 33 u. 34; Lüttschwager, Arch. f. Naturg. Abt. A, Heft 10 (1914) 20.

Alcyonium elegantissimum May, Jena. Z. 33 (1899) 106, t. 1, f. 13.

Alcyonium klunzingeri Thomson, Simpson, Henderson, Alcyonarians collected by the Investigator II. The Alcyonarians of the Littoral Area (1909) 2.

Fundorte.—Palawan, Taytay Bay und Shark's Fin Bay (*Light*); Batas Island (*Light*). Mindoro, Sabong Cove, near Port Galera Bay (*Griffin*).

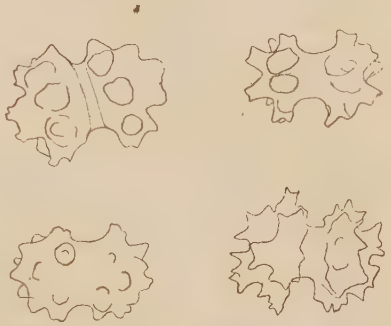

Fig. 1. *Alcyonium pachyclados* Klzgr., Stielskleriten. Vergr. × 200.

Diagnose.—"Von einem kurzen Stiel, der bis auf einen geringen Rest unausgebildet sein kann, erheben sich eine Anzahl Fortsätze. Diese sind dick, oben meist stumpf, breit, fingerförmig, länger als breit, selten mehr kuglig. Sie stehen locker und wenig gedrängt. Die Polypen können ausgestreckt, aber auch ganz zurückgezogen sein. Die Kolonie ist gewöhnlich weich. Die Kalkkörper des Coenenchyms sind grosse, kräftige Doppelkugeln mit zahlreichen zackigen Dornen. Die Mitte der Kalkkörper bildet ein kurzer dornenloser Hals, der Hals ist im allgemeinen nicht eingezogen oder verschmälert. Die Länge der Spicula ist 0.08–010 mm, die Breite 0.06 mm. Die Länge des Halses ist 0.005–0.012 mm.

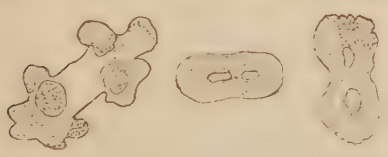

Fig. 2. *Alcyonium pachyclados* Klzgr., Rindenskleriten. Vergr. × 400.

Die Kalkkörper der Rinde sind elliptisch oder achtförmige Gebilde, daneben gibt es auch grössere zylindrische mit Dornen. Länge 0.04–0.05 mm, Breite 0.02 mm."

Verbreitung.—Rotes Meer, Malediven, China Straits, Neubritannien, Kap der guten Hoffnung, Golf von Manaar, Tamatave (Ost Madagaskar) Sansibar, Westaustralien, Javasee, Vitiinseln, Nikobaren, Cocosinseln, Andamanen, Luzon (Albay), Mindoro, und Palawan.

Ich folge im wesentlichen Klunzinger und meiner früheren Diagnose (1914). Was ich früher bereits betonte möchte ich hier auch noch einmal hervorheben, nämlich die Variabilität im äusseren Habitus der Kolonien. Ebenso wechselt die Farbe der konservierten Exemplare von weiss bis braun. Die Kolo-

nien haben ein anderes Aussehen, wenn die Polypen eingezogen, ja tief versteckt sind, wie es bei dem früheren *A. klunzingeri* der Fall ist, das ja auch in den Formenkreis von *pachyclados* gehört—ein anderes Aussehen, wenn die Polypen nicht zurückgezogen sind, sondern alle Aeste überziehen wie Blüten. Auch die Härte der Exemplare ist verschieden. Am härtesten sind die Kolonien deren Polypen ganz zurückgezogen sind, so dass fast eine netzförmige Struktur entsteht, wie *A. klunzingeri* sie zeigt. Diese Kolonien haben auch den kürzesten Stiel, sie sind mit kleiner Basis angeheftet, der kurze Stiel erweitert sich sehr rasch und trägt die kurzen Fortsätze. Eine geringe Basalanheftung scheint mir überhaupt characteristisch für diese Art zu sein und ebenso die schnelle Verbreitung des Stieles. Je nachdem wird die Kolonie höher oder bleibt niedrig, fast inkrustierend. Die fingerförmigen Fortsätze sind bei den meisten Exemplaren 3–4 cm lang, nur bei einem meiner Exemplare sind sie bis 5 cm lang. Die mir vorliegenden Exemplare von den Philippinen ähneln dem *A. elegantissimum* May, das ich auch zu *A. pachyclados* stelle. Bei dieser Form sind die fingerförmigen Fortsätze etwas schmaler und länger als gewöhnlich. Diese Verschiedenheiten im Bau hängen meiner Ansicht nach von den Standortsverhältnissen ab und sind nur als solche zu bewerten. Mir erscheint die Form und Grösse der Spicula, die bei allen die gleiche ist, als das wertvollere Characteristicum der Art. Auch die übrigen Bearbeiter dieser Art heben deren Variabilität hervor.

Alcyonium digitulatum Klunzinger. Tafel 1, Fig. 2.

Alcyonium digitulatum KLUNZINGER, Korallt. d. rot. Meer. 1 (1877) 24, t. 1, f. 3; COHN, Alcyonarien von Madagask. u. Ostafr. 2 (1908) 236; LÜTTSCHWAGER, Arch. Naturg. Abt. A. Heft 10 (1914) 24.

Fundort.—5 Exemplare. "From shallow reefs at Batas Island on the east coast of Palawan." (*Light.*)

Diagnose.—"Ein kurzer Stiel verzweigt sich in eine Anzahl von Lappen, die ihrerseits Läppchen bilden; diese stehen nicht so dicht wie bei *A. sphaerophorum*, sind meist kurz, fingerförmig, schmal, etwas länger wie breit. Die Polypen sind meist nicht ganz zurückgezogen, so dass die Kolonie wollig erscheint. Die Rindenspicula sind bis 0.05 mm grosse, 0.016 mm breite, längliche Ellipsen mit oder ohne helleren Hals, meist ohne deutliche Einschnürung. Die Coenenchymspicula der Scheibe haben meist einen langen Hals, der aber nicht verschmälert zu sein braucht, und wenige grosse Dornen an beiden Enden. Die Coenenchymspicula des Stieles haben einen kurzen Hals, der stark eingezogen

ist. Die Enden der Spicula sind dann zu grossen Köpfen erweitert. Die Länge der Spicula ist 0.07–0.08 mm, die Breite der Köpfe beträgt bis 0.06 mm. Die Farbe der Kolonie ist grauweiss, die Polypen sind dunkler. Die Consistenz ist lederartig."

Fig. 3. *Alcyonium digitulatum* Klzgr., Rinden- und Stielskleriten. Vergr. × 200.

Verbreitung.—Rotes Meer, Kokotari (Sansibar), Batas Insel (Palawan). Durch die mir vorliegenden 5 Exemplare kann ich Klunzingers Angaben bestätigen, während mir bei meiner ersten Revision kein Material vorlag. Diese Art hat in ihren Spicula eigentlich nichts sehr characteristisches, dafür unterscheidet sie sich, wie ich an den mir vorliegenden Exemplaren feststellte, durch ihren Habitus von den übrigen Arten. Der Habitus ist doch derartig, dass er sich nicht in den Formenkreis einer anderen Art einfügen lässt. Zu bemerken ist noch, dass neben vielen Rindenspicula ohne hellere Mitte auch einige vorkommen die diese besitzen.

Alcyonium equisetiforme n. n. Tafel 1, Fig. 3.

Alcyonium paessleri MAY, Alcyon. Ergeb. Hamburg. Magulh. Sammelreise (1899) 6; HICKSON, Nat. antract. Exp. nat. hist. 3 (1907) 3, t. 2, f. 22, 23.

Fig. 4. *Alcyonium equisetiforme* n. n., Rindenskleriten Vergr. × 200.

Fundorte.—Mindoro, Port Galera Bay, 8 Exemplare (*Light*).

Diagnose.—"Von einem dicken runden Stamme gehen einige wenige Aeste ab, die sich in runde, etwa 3 cm lange, fingerförmig zugespitzte Fortsätze verzweigen. Die Kolonie macht mit ihrem dicken, langen Stamm und der dichten Verzweigung am oberen Ende einen baumförmigen Eindruck, so dass man deutlich einen Stamm und eine Krone unterscheiden kann. Die Polypen stehen vereinzelt auch an dem oberen Ende des Stammes. Die Spicula sind hauptsächlich auf den Stamm beschränkt. Bei den grösseren Formen haben sie die Form einer Walze, die an beiden Enden zugespitzt ist. Eine schwache Einschnürung in der Mitte deutet auf die typische Alcyoniumform hin. Die Walzen sind

Fig. 5. *Alcyonium equisetiforme* n. n., Stielskleriten. Vergr. × 200.

unregelmässig, aber dicht bewarzt, meist 0.1–0.2 mm lang und 0.06 mm breit. Im Coenenchym der Zweige liegen wenige schmale Stäbe. Die Konsistenz der Kolonie ist weich während der Stamm fester ist. Die Farbe der Alkoholexemplare ist gelb bis bräunlich."

Verbreitung.—Franklin Insel, Antarctik, Port Galera Bay, Mindoro. Wie ich bereits oben angeführt habe, rechne ich meine Exemplare zu der von Hickson *A. paessleri* gestellten Art. Meine kleineren Exemplare haben schmale Spindeln, wie sie auch Hickson beschreibt; die grossen besitzen dickere, stärkere walzenartige Spicula.

Von den andern, in der Ausbeute nicht vertretenen Arten sollen nur die verbesserten Diagnosen nebst kurzen Bemerkungen gegeben werden.

Alcyonium digitatum Linnæus.

Alcyonium digitatum Linnæus, Syst. Nat. ed. 10 1 1758) 803; Ellis und Solander, Zooph. (1786) 175, pl. 1, fig.; Johnston, Hist. British Zooph. (1847) 174, pl. 34; Milne-Edwards, Hist. Nat. Corrall. 1 (1857) 118; Storm, Norske Selsk. Skr. 1884 (185) 45; Oversigt over Trondjemfjordens Fauna (1901) 3; Hickson, Quart. Journ. Micr. Sci. London n. s. 37 (1895) 343, Alcyonium (1901) 92; The Alcyonarian, Bay of Biscaya (1907) 7; Roule, Résult. scient. de la campagne du Caudan (1896) 306; Nordgaard, Hydrogeographical and biological investigations in Norwegian fjords (1905) 158; (pars) Nordgaard. Mofjordens Naturforhold (1907) 19; Pratt, The digestive organs of the Alcyonaria and their relation to the mesogloeal cell plexus (1905); Kükenthal, Alcyonaria der deutschen Tiefsee-Exp. 13 (1906) 42; Stephens, Alcyonarian and madreporarian corals of the Irish coast (1909) 4; Broch, Die Alcyonarien des Trondjemfjordes, I. Alcyonacea. Norske Selsk. Skr. 1911 (1912) 27.

Diagnose.—"Die Kolonien sind rund, fest, dick, fleischig und aufrecht stehend, oft handförmig in einer Ebene verzweigt, und vollkommen mit Polypen bedeckt. Die ausgestreckten Polypen sind gross und hyalin. Die Coenenchymspicula sind meist kreuzförmig gestaltete, auch weiter verzweigte, schlanke Spindeln, mit locker stehenden langen Dornen, durchschnittlich 0.2 mm lang.

"Die dicht liegenden Rindenspicula zeigen eine hantelförmige Ausbildung, die häufig durch sehr kräftige und verzweigte rauhe Warzen verwischt ist, so dass sie ebenfalls kreuzförmig erscheinen können. Sie sind durchschnittlich 0.06–0.07 mm lang.

"Die Polypen sind mit 8 Reihen locker liegender, schmaler Spicula bewehrt, die schwach bedornt sind und meist eine Länge von 0.2 mm haben. Diese Spiculabewehrung erstreckt sich vom oberen Teil des Schlundrohres bis in den Grund der Tentakel. Farbe der Kolonie orange bis weisslich."

Verbreitung.—Europäische Meere, in der littoralen und in den oberen Teilen der abyssalen Region.

Alcyonium compressum Th. Studer.

Alcyonium glomeratum STUDER, Note préliminaire sur les Alcyon. de l'Hirondelle 4 (1891) 555.

Alcyonium compressum STUDER, Alyconaires de l'Hirondelle, fasc. 20 (1901) 22, tab. 3, fig. 1.

Diagnose.—"Die Kolonie hat die Form eines lamellenartigen Blattes, von dem sich abgeplattete und gerundete Lappen bis zu einer Höhe von 42 mm erheben. Die Oberfläche der Lappen ist hart und ledern. Die Polypen sind vollkommen zurückziehbar. An der ganzen Oberfläche des Polypariums liegen kräftige Spicula in Form von dornigen Keulen, von Spindeln mit langen Dornen und einigen verzweigten, unregelmässigen bedornten Körpern eine harte lederartige Rinde. Die Länge der Spicula beträgt 0.72–0.1 mm, ihre Dicke 0.01–0.03 mm. Die Coenenchymspicula sind lange, gerade oder gekrümmte Stäbe, mit kurzen und entfernt stehenden Dornen besetzt, von 0.21–0.3 mm Länge. In den Tentakeln befinden sich Spindeln mit starken, rotgefärbten Dornen von 0.12 mm Länge, 0.03 mm Dicke, neben kleineren ungefärbten Stäbchen. Die Farben der Kolonie ist fleischrot, die der Tentakel und des zurückziehbaren Teiles der Polypen ist intensiv rot."

Verbreitung.—Golf von Biscaya.

Studer hat in seiner "Note préliminaire sur les Alcyon. de l'Hirondelle" diese Art zuerst mit *Alcyonium glomeratum* Hassall identifiziert, schreibt dann aber zum Schlusse, dass seine neue Art zwar verwandt scheine dem *Alcyonium glomeratum* Hassall (*Rodophyton couchii* Gray) durch seine harte Rinde, doch bilde die letztere Art fingerförmige, zylindrische Lappen, besonders bei dem Exemplar das für Gray den Typus seiner *Rodophyton couchii* darstelle. Bei dieser Art seien auch die Kelche viel mehr hervorstehend, "striés et quelquefois adhérents par un côte de leur paroi au coenenchym de sorte qu'ils ont la forme d'un nid d'hirondelle." Diese Eigenschaft, die besonders in der Abbildung Grays betont sei, erscheine weniger in der Abbildung von *A. glomeratum*, die Hickson gab. Die Spicula, die zum ersten Male durch Hickson dargestellt seien, "sont assez différents de ceux de notre espèce." Studer identifiziert also Hicksons *A. glomeratum* doch nicht mit seinem *A. compressum* und hat darin Recht; denn nach seiner Zeichnung und Beschreibung ist es eine andere Art, wenngleich ja leider jede Spiculazeichnung fehlt. Mir scheint es, dass *A. compressum*

Stud. wie *A. glomeratum* Hassall sich nahe an *A. digitatum* L. anschliessen.

Alcyonium glomeratum Hassall.

Alcyonium glomeratum HASSALL, Ann. & Mag. Nat. Hist. 11 (1843) 112; JOHNSTON, Hist. British Zooph. (1847) 178; HICKSON, Quart. Journ. Micr. Sci. London n. s. 37 (1895) pl. 4, non *Alcyonium glomeratum* Hiles, in Willey, Zool. Results pt. 4 (1900) 503; STUDER, Note préliminaire sur les Alcyon. de l'Hirondelle 4 (1891) 555.
Alcyonium sanguineum COUCH, The Cornish Fauna (1843) 60, Taf. 13, fig. 1.
Rodophyton couchii GRAY, Proc. Zool. Soc. London (1865) 706.

Diagnose.—"Die Kolonie ist ähnlich gebaut wie *A. digitatum*, unterscheidet sich jedoch von ihr dadurch dass die Lappen mehr zugespitzt, schlanker und tiefer geteilt sind und locker stehen. Die Polypen können zurückgezogen oder ausgestreckt sein. Die roten Spicula sind schmale bedornte Spindeln von 0.2–0.4 mm Länge, und Keulen, die am schmalen Ende schwach, oben stärker bedornt sind. Die Farbe der Kolonie ist gelbrot."

Verbreitung.—Küsten Gross-Britanniens, Norwegen; Talili-Bai, Neu-Britannien (?).

Wie Hickson schon ausführte, ist auf die Tatsache, dass die Polypen ausgestreckt oder zurückgezogen sind, kein Gewicht zu legen; denn dies kann verschiedene uns unbekannte Gründe haben. Dagegen sind der abweichende Bau, die meist tiefrote Farbe der Kolonie und die anders als bei *A. digitatum* gebauten Spicula ein wesentliches Unterscheidungsmerkmal der beiden Arten.

Alcyonium palmatum Pallas.

Alcyonium palmatum PALLAS, Elench. zooph. (1766) 349; LAMOUROUX, Hist. des polyp. corall. (1816) 335; DANA, Zooph. (1846) 615; M. SARS, Bidrag til Kundsgaben am Middelhavets Littoralfauna, Reise-bemaerkninger fra Italien (1857) 3; KÖLLIKER, Icon. Hist. (1865) 132; v. KOCH, Mitt. Zool. Stat. Neapel. 9 (1891) 663; KÜKENTHAL, Jena. Z. 42 (1906) 62.
Lobularia palmata LAMARCK, Hist. Nat. An. s. vert. 2 (1816) 214; EHRENBERG, Korallt. d. Rot. Meeres (1834) 282.
Lobulaire palmé BLAINVILLE, Man. Actin. (1834) 522.

Diagnose.—"Von einem im unteren Teile sterilen, meist säulenförmig hochgewachsenen Stamme gehen eine Anzahl zierlicher, schlanker, runder Aeste ab, die rings mit—im ausgestreckten Zustande bis 8 mm langen—Polypen besetzt sind. Diese Hauptäste senden noch Nebenzweige ab, doch stehen alle locker und sind nicht gleich lang, so dass der polypentragende Teil der Kolonie an keiner Stelle einen gedrängten oder dichten

Eindruck macht. Von Spicula kommen in der Rinde erstens Gebilde vor, deren Hantelform verwischt ist und die mehr Doppelkreuzen gleichen, das heist, einem Stabe, der mit zwei Dornenkränzen versehen ist. Ihre Länge beträgt durchschnittlich 0.06 mm. Ferner kommen grössere, plumpere Spicula vor, die unregelmässig bedornt sind. Im Coenenchym liegen 0.2 mm lange, ganz schmale, schwach bedornte Nadeln. Die Farbe der Kolonie ist gelblich, gelb bis orange, der Stiel kann auch ganz rot erscheinen. Die Farbe wird durch die gefärbten Spicula erzeugt. Die Polypen sind mit schmalen, schwach bedornten, bis 0.4 mm langen Nadeln bewehrt, die sich, dicht liegend, bis in die Tentakel erstrecken."

Verbreitung.—Mittelmeer.

Alcyonium brioniense Kükenthal.

Alcyonium brioniense KÜKENTHAL, Jena. Z. 42 (1906) 61, t. 4.

Diagnose.—"Die Kolonien sind kleiner als die von *A. palmatum*. Von einem dicken, langen, sterilen Stammteile gehen wenige kurze Zweige ab. Die gesamte Kolonie ist undurchsichtig. Die hellgelben Polypen sind klein, halb so gross wie bei *A. palmatum*. Die Tentakel sind am Grunde breit und werden nach oben spitz, die untersten Pinulä sind sehr lang, die obersten kurz. Die Farbe der Kolonie ist dunkelpurpurrot mit hellgelben Polypen. Die Wandung der Polypen ist sehr dicht mit transversalen Spicula bedeckt. Diese konvergieren nach oben und treten in die Achse der Tentakel ein. Sie sind schlanker als bei *A. palmatum* und bis 0.24 mm lang. In der Rinde der Aeste liegen kleine plumpe Spicula von 0.06–0.12 mm Länge, mit wenigen grossen Dornen besetzt. In der Stammrinde sind bis 0.15 mm lange plumpe Spindeln. Im Coenenchym liegen gestrecktere, schlankere Formen von 0.25 mm Länge mit wenigen grossen Dornen versehen. Die Spicula haben fast stets rote Farbe. Die Farbe der Kolonie ist stets dunkelrot mit gelben Polypen."

Verbreitung.—Brionische Inseln.

Alcyonium adriaticum Kükenthal.

Alcyonium palmatum forma *adriatica* KÜKENTHAL, Jena. Z. 42 (1906) 70.

Alcyonium adriaticum KÜKENTHAL, Beob. an einigen Korallentieren d. adriatischen Meer. Aus der Natur (1909) 323.

Diagnose.—"Die Verzweigung ist plumper als bei *A. palmatum* und erfolgt meist in einer Ebene (manus marina). Die Kolonie ist nicht so durchscheinend wie *A. palmatum* aber

durchsichtiger als *A. brioniense*. Die Polypenstellung ist dieselbe. Die Spicula der Stammrinde sind breite flache Platten, 0.12 mm lang, 0.06 mm breit, mit wenigen abgeflachten breiten Dornen. Die Spicula des oberen Teiles der Kolonie sind sehr ähnlich denen von *A. palmatum*. Farbe meist ockergelb bis orange-gelb."

Verbreitung.—Nördliches adriatisches Meer.

Alcyonium brachyclados (Ehrenberg).

Alcyonium tuberculosum QUOY und GAIMARD, Voy. Astrolabe (? 1833) 274, t. 23, f. 4 und 5.
Lobularia brachyclados EHRENBERG, Korallt. d. rot. Meer. (1834) 282.
Alcyonium brachyclados DANA, Zooph. (1846) 617; KLUNZINGER, Korallt. d. rot. Meer. 1 (1877) 25, t. 1, f. 4; COHN, Alcyonarien von Madagaskar u. Ostafrika (1908) 234; LÜTTSCHWAGER, Arch. Naturg. Abt. A, Heft 10 (1914) 22.

Diagnose.—"Der Habitus ist derselbe wie *A. pachyclados*. Die Coenenchymspicula sind jedoch schlank, langhalsig mit wenig verbreitertem Kopfe, gleichen mehr an beiden Enden bestachelten Zylindern als Doppelkeulen. Die Rindenspicula sind trübe Ellipsen oder mehr hantelförmige Gebilde ohne hellen Hals und sind 0.05 bis 0.06 mm lang, 0.02 bis 0.03 mm breit. Die Coenenchymspicula sind 0.06 bis 0.08 mm lang, 0.02 bis 0.05 mm breit. Die Farbe der konservierten Exemplare ist dunkelgraugrün, die Consistenz der Kolonie ist weich."

Verbreitung.—Rotes Meer, Tamatave, Tonga?

Die von Klunzinger aufgestellte var. *elongata* unterscheidet sich von der Stammform durch längere, mehr fingerförmige Läppchen, stimmt aber in der Gestalt der Kalkkörper ganz mit dem typischen *A. brachylados* überein. Wie ich bereits ausführte, hat Whitelegge eine von ihm beschriebene neue Sinularia-art zu Unrecht mit *A. tuberculosum* Q. u. G. identifiziert das er zu *Lobophytum* stellt; dazu bemerke ich folgendes.

Alcyonium tuberculosum Q. u. G. ist warhscheinlich ? *Alcyonium brachyclados; Lobophytum tuberculosum* Whitelegge ist *Sinularia whiteleggei* Lüttschwager.[3] Der Name *A. tuberculosum* Q. u. G. ist zwar älter als *A. brachyclados* (Ehrbg.), trotzdem ist der letztere Name beizubehalten; denn bei dem Mangel jeglicher Spiculaabbildung bezüglich Beschreibung kann diese Art Quoy und Gaimards nicht als "ausreichend beschrieben" bezeichnet werden.

[3] Lüttschwager, Arch. f. Naturg. Abt. A, Heft 10 (1914) 13.

Alcyonium sphaerophorum (Ehrenberg).

Lobularia sphaerophora Ehrenberg, Korallt. d. rot. Meer. (1834) 57.
Alcyonium sphaerophorum Dana, Zooph. (1846) 616, Synopsis (1859) 123; Milne-Edwards, Hist. Nat. Corallt. 1 (1857) 119; Klunzinger, Korallt. d. rot. Meer. 1 (1877) 22, t. 1, f. 1; May, Jena. Z. 33 (1902) 105; Cohn, Alcyonarien von Madagaskar u. Ostafr. 2 (1908) 231; Thomson und Russell, Alcyonar. coll. on the Percy Sladen Trust exp. by J. Stanley Gardiner (1910) 174; Lüttschwager, Arch. Naturg. Abt. A, Heft. 10 (1914) 23.
Cladiella sphærophora Gray, Ann. & Mag. Nat. Hist. III 3 (1869) 125.

Diagnose.—"Die Kolonie ist halbkugelig, mit niederem breitem Fuss. Die Lappen sind flach kugelig, stehen dicht gedrängt, so dass sie sich gegenseitig abplatten, sind breiter als hoch und haben so dass Aussehen von Gehirnwindungen. Die Lappen sind Gruppen einer Anzahl von Läppchen und sind 15–20 mm breit. Die Rindenspicula sind kleine, schmale sogenannte Biskuitformen mit hellem Fleck in jeder Hälfte. Die Coenenchymspicula sind stachelige Doppelkeulen mit nackter Einschnürung. Ihre Länge ist 0.03–0.06 mm, ihre Breite 0.015–0.03 mm. Die Farbe der konservierten Kolonien ist weissgrau."

Verbreitung.—Rotes Meer, Tubar Riff (S. W. Madagaskar), W. Australien, Talili, Praslin, Seychellen.

Alcyonium sphaerophorum var. sansibaricum Cohn.

Alcyonium sphaerophorum var. *sansibaricum* Cohn, Alcyonarien von Madagaskar u. Ostafr. 2 (1908) 233; Lüttschwager, Arch. Naturg. Abt. A, Heft 10 (1914) 24.

Diagnose.—"Im allgemeinen ist die Kolonie so gebaut wie *A. sphaerophorum,* jedoch sind die einzelnen Läppchen relativ grösser wie bei der Stammform. Diese erheben sich auf sehr kurzem, sterilem Stiele, zumeist gesondert, ohne sich zu Bündeln zu vereinigen. An der Oberfläche zeigen sie dasselbe Bild wie *A. sphaerophorum.* Die Kolonie hat ein blumenkohlartiges Aussehen. Die Polypen sind meist vollkommen zurückgezogen. Die Spicula sind im wesentlichen die gleichen wie bei *A. sphaerophorum,* zeigen deren Hantelform und zeichnen sich durch grosse Helligkeit aus. Die Farbe und Consistenz ist dieselbe wie bei *A. sphaerophorum.*"

Verbreitung.—Sansibar.

Ich gebe diese Diagnose nach der Beschreibung Cohns. Aus ihr ist zu ersehen, dass er den Habitus der Kolonie als das einzige Unterscheidungsmerkmal angesehen hat; denn die Abweichungen im Bau der Spicula sind zu unbedeutend. Wir

haben es hier mit einer Form zu tun, die sich eng an die Stammform anschliesst, vielleicht auch nur eine Standortsvarietät ist.

Alcyonium globuliferum Klunzinger.

Lobularia sphaerophora TARGIONI-TOZZETTI, Atti Soc. Ital. 15 (1872) 4.
Alcyonium globuliferum KLUNZINGER, Korallt. d. rot. Meer. Teil 1 (1877) 23, t. 1, f. 2; LÜTTSCHWAGER, Arch. Naturg. Abt. A, Heft. 10 (1914) 23.

Diagnose.—"Das Aussehen der Kolonie erscheint gehirnartig, indem einander abplattende, flachkugelige, kurze Lappen und Läppchen in deutlicher Gruppierung mit engen Furchen sich zwischen den Läppchen finden, welche oft wie eingeschnürt erscheinen. Die Läppchen sind selten über 4–6 mm breit und 2–4 mm hoch. Jede Läppchengruppe sitzt auf einem sterilen Stiel von 0.5–1 cm Höhe, welcher dem gemeinsamen Fuss der Kolonie aufsitzt. Die grösseren Läppchengruppen oder Lappen sind 2–3 cm breit. Die Kolonie ist an der Oberfläche etwas gewölbt. Die Rindenspicula sind dornlose Doppelkugeln mit sehr deutlichem, schmalerem und helleren aufgesetztem Hals, ihre Länge ist 0.040–0.056 mm, ihre Breite 0.025 mm. Die Coenenchymspicula sind Hanteln mit dornenlosem kaum verschmälertem Hals. An ihren Enden stehen starke, stumpfe Dornen und Höcker, die auch zugespitzt sein können. Ihre Länge ist 0.06–0.10 mm, ihre Breite 0.05 mm."

Verbreitung.—Rotes Meer.

Alcyonium ceylonense May.

Alcyonium ceylonense MAY, Beitr. z. System. u. Chorologie d. Alcyonaceen, Jena. Z. 33 (1899) 109; LÜTTSCHWAGER, Arch. Naturg. Abt. A, Heft 10 (1914) 25.
Alcyonium ceylonicum PRATT, Report on the pearl oyster fisheries of the Gulf of Manaar (1905) 257.

Diagnose.—"Die Kolonie bildet derbe, fleischige Massen, deren Rand aufwärts gebogen ist. Auf der Oberfläche stehen wenige, zerstreute, oft hahnenkammartige gefaltete Lappen. Die Rindenspicula sind reich mit Warzen besetzte Keulen und Stäbe. Die Coenenchymspicula sind sehr stark eingeschnürte Doppelkeulen mit stark entwickelten und mit vielen bedornten Warzen besetzten Enden. Die Einschnürung ist 0.06 mm breit. Die Länge der Spicula ist 0.285 mm (0.14–0.1 mm nach Pratt)."

Verbreitung.—Ceylon, Riff bei Galle.

Die Farbe der Kolonie wird von May als braun angegeben, von Pratt als cremeweiss. Wie bei *A. pachyclados* scheint sie auch bei dieser Art zu wechseln.

Alcyonium etheridgei J. A. Thomson und D. L. Mackinnon.

Alcyonium etheridgei Thompson und Mackinnon, Alcyonarians of the Thetis Exp., Mem. Mus. Austr. 4[18] (1911) 166, pl. 61, f. 2 u. 3, pl. 62, f. 3, pl. 67, f. 4, pl. 69.

Diagnose.—"Von einer leicht inkrustierenden Basis erhebt sich ein kräftiger Stiel. Dieser ist sehr fest und hat eine ziemlich rauhe, faltige Oberfläche. Der Stiel teilt sich in eine Anzahl kräftige, fingerförmige Lappen von 1–2 cm Durchmesser. Diese Lappen teilen sich weiter in neue von gewöhnlich 0.5–0.75 cm Höhe, mit einem Durchmesser von 1.75 cm Höhe. Die ganze Oberfläche erscheint dicht besetzt mit weissen Spicula. Diese sind derbe Doppelkeulen mit abgesetztem Hals und mit zwei Kränzen von vorspringenden Warzen. Ihre Länge ist 0.08–0.18 mm, ihre Breite 0.08–0.11 mm; jedoch gibt es auch kleinere Formen. Die Spicula der Polypen sind Spindeln und Keulen von dünner Form mit einigen vorspringenden Warzen von 0.17–0.30 mm Länge. Die Farbe der Kolonie ist graubraun bis dunkelbraun, die Polypen sind dunkler."

Verbreitung.—Manning Bight.

Alcyonium paessleri May.

Alcyonium paessleri May, Alcyonar. Erg. Hamburg. Magalh. Sammelr. (1899) 6 u. 7, Fauna arctica 1 (1900) 403; Hickson, Nat. Antarct. Exp. Nat. Hist. 3 (1907) 3, t. 2., f. 22, 23.

Diagnose.—"Die unregelmässig gestaltete Kolonie besteht aus einer langgestreckten, stellenweise zu kugeligen Wülsten angeschwollenen Coenenchymmasse, auf der sich konische Papillen erheben, in die die Polypen vollständig zurückziehbar sind. Basalteil und Lappen sind nicht deutlich von einander abgesetzt. Die Rindenspicula sind stark bedornte Keulen von 0.07–0.14 mm Länge. Die Coenenchymspicula sind bis 0.21 mm lange Spindeln und Stäbe mit langen, locker stehenden Dornen. Die Polypenspicula sind spindelförmig, 0.42 mm lang, 0.035 mm breit, mit kürzeren und dichter stehenden Dornen versehen als die Coenenchymspicula. Die Farbe der Alkohol-exemplare ist durchweg weisslich."

Verbreitung.—Smyth Kanal.

Nicht identisch mit *A. paessleri* May sind die von Hickson 1902 und 1907 beschriebenen Exemplare. May beschreibt *A. paessleri* als eine unregelmässig gestaltete Kolonie, die aus einer langgestreckten, stellenweise zu kugeligen Wülsten angeschwollene Coenenchymmasse besteht, auf der sich konische Papillen

erheben. Ganz anders lautet Hicksons Beschreibung, nämlich, "es erheben sich 13 stumpfe Lappen." Mir liegen 8 Exemplare von den Philippinen vor. Diese zeigen nun einen solchen Habitus wie ihn Hickson beschreibt und wie sich aus Hicksons Abbildung erkennen lässt. Hickson lagen offenbar junge Exemplare einer andern Art vor. Das kleinste meiner Exemplare zeigt die Spiculaform wie Hicksons *A. paessleri.* Die grösseren Exemplare zeigen stärkere Spicula, die mehr Walzenform mit einer Einschnürung annehmen. Ich halte daher nach meinem Befinden, Hicksons Art für nicht identisch mit Mays *A. paessleri.* Sie müssen auseinander gehalten werden und Hicksons Art muss deshalb einen neuen Namen erhalten. Ich nenne sie, weil die Aeste der fertilen Sprossen der Gattung *Equisetum* sehr ähnlich sehen, *Alcyonium equisetiforme.*

Alcyonium fallax n. n.

Alcyonium purpureum HICKSON, Alcyonaria of the Cape of Good Hope, pt. 2 (1904) 215, t. 7, f. 1, t. 9, f. 18; THOMPSON, Trans. Roy. Soc. Edinburgh, pt. 3 (Nr. 19) 47 (1910) 566, pl. 3, f. 16, pl. 4, f. 24 und 25; LÜTTSCHWAGER, Arch. Naturg. Abt. A, Heft 10 (1914) 26.

Diagnose.—"Die Kolonie besitzt weder Stamm noch Stiel. Von einer inkrustierenden Scheibe erheben sich eine Anzahl Lappen. Die Polypen zeigen auf den Lappen die Tendenz, sich spiralig anzuordnen, sie sind vollständig zurückziehbar, oft aber ausgestreckt. Die Spicula der Basalverbindung sind stark eingeschnürte Hantelformen mit einigen grossen Dornen und Warzen. Ihre Länge ist 0.08 bis 0.12 mm und ihre Breite 0.08 bis 0.09 mm. Die Rindenspicula sind Spindeln, Kugeln, Doppelkugeln, und Doppelkeulen mit vorspringenden Warzen. Die Spindeln haben eine Länge von 0.08–0.2 mm, die Kugeln und Doppelkugeln 0.11–0.17 mm, die Keulen und Doppelkeulen von 0.08–0.14 mm. Die Coenenchymspicula sind Kugeln und Doppelkugeln von 0.1–0.3 mm Länge. Die Polypenspicula sind Spindeln (0.10–0.11 mm Länge), Kugeln, Doppelkugeln und Keulen. Die Farbe der Kolonie ist prächtig rot."

Verbreitung.—Morsel Bay, Kap Kolonie, und zwischen Roman Rock und Kap Recife.

Der Name *A. purpureum* ist bereits von Lamarck vergeben worden und zwar für eine Form die wohl als Schwamm anzusprechen ist. Nach den bestehenden Nomenklaturregeln muss deshalb der Name geändert werden, und ich wähle dafür die Bezeichnung *A. fallax.*

Alcyonium valdiviae Kükenthal.

Alcyonium valdiviae KÜKENTHAL, Alcyonaria der deutschen Tiefsee-Exp. (1906) 42, t. 3, f. 11, t. 8, f. 39–41.

Diagnose.—"Der massige Stamm sendet einige kurze, plumpe Hauptäste ab, von deren oberem Teile zahlreiche, kurze, konisch geformte Endäste nach allen Richtungen entspringen, diese verjüngen sich nach oben und enden stumpf konisch. Die Polypen sind sämtlich zurückezogen und erscheinen als kleine flache Warzen; sie treten auch auf den Hauptstamm über. Die Oberfläche der Kolonie ist matt, fast rauh. Die Rindenspicula liegen dicht angeordnet, sind meist rötlich gefärbt und mit zwei Gürteln sehr grosser Dornen versehen, im allegemeinen Umriss ovale Körper von 0.04 mm Länge. Coenenchymspicula finden sich nur im Stamm in ähnlicher Form wie sie die Rindenspicula zeigen, von 0.04 mm Länge."

Verbreitung.—Agulhasbank.

Alcyonium fauri J. A. Thomson.

Alcyonium fauri THOMSON, Trans. Roy. Soc. Edinburg pt. 3 (Nr. 19) 47 (1910) 568, t. 1, f. 5, t. 4, f. 44.

Diagnose.—"Die Kolonie ist inkrustierend und besteht aus einer ziemlich harten, kompakten Masse mit nahestehenden, polypentragenden Lappen. Jeder Lappen hat mehr oder weniger halbkreisförmige Form. Die Polypen stehen kontinuierlich im weichen Coenenchym. Die Lappen haben keine Stiele, sondern kommen aus gemeinsamer, horizontaler inkrustierender Scheibe. Diese basale Scheibe ragt an einzelnen Stellen über den Basisrand der Polypenlappen hinaus und ist mit zahlreichen Spicula bedeckt. Die Zahl der Lappen beträgt über 20. Die Kolonie misst 41 mm Länge, 32 mm Breite, und 9.5 mm Höhe. Die Zahl der Polypen in den Lappen ist sehr verschieden. Ein grosser Lappen ist 11 mm lang, 11 mm breit, und 9 mm hoch. Die Polypen sind zahlreicher und besser am Rande als im Mittelpunkt der Lappen ausgebildet. Die Polypen können ausgestreckt aber auch ganz zurückgezogen sein; ausgestreckte ragen über 3 mm über die Oberfläche hervor. Spicula befinden sich im Basalteil und im Coenenchym an der Polypenbasis. Im Innencoenenchym fehlen sie. Sie haben die Form von Hanteln mit ganz schwacher Einschnürung, sind 0.09–0.12 mm lang und 0.06–0.09 mm breit. Die Farbe ist hellbraun."

Verbreitung.—Kap St. Blaize.

Alcyonium gracillimum Kükenthal.

Alcyonium gracillimum KÜKENTHAL, Zool. Anz. 30 (1906) 284, Japan. Alcyonac., Abh. K. Bayr. Ak. Wiss. II. Kl. Suppl. 1 (1906) 34, t. 2, f. 13; NUTTING, Proc. U. S. Nat. Mus. 43 (1913) 21.

Diagnose.—"Von der lederigen membranösen Basis erhebt sich ein sehr dicker, walzenförmiger, steriler Stiel, der einige plumpe Seitenäste abgibt, die mit Polypen besetzt sind. Die Polypen stehen in kleinen rundlichen Bildungen von 2 mm Durchmesser zusammen. Diese stehen am Hauptstamm mehr vereinzelt, an den kurzen Aesten dagegen eng zusammen und bilden so grössere blumenkohlartige Gebilde. Die Polypen sind vollkommen zurückgezogen. Die Polypen besitzen Spicula in der Form von etwas gekrümmten Spindeln, die mit hohen runden Dornen besetzt sind. Ihre Länge ist 0.3 mm. In der Stammrinde finden sich etwas dickere, meist gebogene Stäbe von 0.25 mm durchschnittlicher Länge mit grösseren, sehr weit stehenden Dornen. Die Coenenchymspicula sind 0.6 mm lange, dicke Spindeln mit grossen, gezackten Warzen, Meist sind sie in der Mitte etwas eingeschnürt. Die Farbe der Kolonie ist gelbbraun."

Verbreitung.—Sagamibucht, Misaki.

SPECIES DUBIÆ

Alcyonium rotiferum J. A. Thomson.

Alcyonium rotiferum THOMSON, Trans. Roy. Soc. Edinburgh pt. 3 (Nr. 19) 47 (1910) 373, pl. 1, f. 3 u. 4, pl. 4, f. 38.

Diagnose.—"Die Kolonie besteht aus einer Anzahl dünner, zylindrischer Lappen, die sich an ihrer Basis miteinander vereinigen. Die Lappen gehen zuweilen in schmalere Lappen und Läppchen über. Die Basis der Stiele ist leicht einwärts gebogen. Die Rinde der Kolonie ist zäh und lederartig und birgt zahlreiche Spicula. Die Oberfläche des Stieles und des polypentragenden Teiles ist durch characteristische Falten gekennzeichnet, die sich in verschiedene Felder teilen und ihr ein runzeliges Aussehen geben. Die Spicula haben die Form von Doppelrädern."

Verbreitung.—Kuskamma.

Mir erscheint die Art als nicht zu *Alcyonium* gehörig, und zwar einmal der Wuchsform wegen—die Kolonie besteht aus einzelnen Lappen, die nur am Grunde schwach zusammenhängen—und zweitens wegen der Form der Spicula. Derartige Spiculaformen gibt es bei keiner Alcyoniumart.

Als weitere Species dubiae sind noch die alten Arten anzuführen:

A. bradleyi Verrill.
A. stellatum M. Edw., vielleicht *A. digitatum.*
A. laniciosum Esper.
A. molle (*stellatum*) Esper.

Von diesen älteren Arten kann ich infolge der mangelhaften Beschreibungen der Autoren keine Diagnose geben.

In der neuerdings erschienenen Arbeit von A. Molander (1915) wird der Versuch gemacht, *Erythropodium norvegicum* als Varietät zu *Alcyonium digitatum* zu ziehen, der indessen bereits von Kükenthal (1916) als nicht zulässig zurückgewiesen worden ist. Was die Identifizierung von *A. compressum* mit *A. glomeratum* anbetrifft, so ist nur *A. compressum* Th. Stud. (1901) synonym mit *A. glomeratum* Th. Stud. (1891), im übrigen sind es aber zwei zu trennende Arten. Die von Molander zu *Alcyonium* gestellte *Gersemia bocagei* (Kent) möchte ich bei der Gattung *Gersemia* belassen.

Zu der seinerzeit (1914) von mir gegebenen Liste zu *Alcyonium* gerechneter aber nicht dazugehöriger Arten ist folgendes hinzuzufügen:

Hartmeyer hat in seinem Aufsatz [4] eine Anzahl solcher Arten aufgeführt, und zu deuten versucht, wozu ich noch einige Bemerkungen beifügen möchte.

Alcyonium pulmonaria Ellis und Solander ist nach Hartmeyer identisch mit der Synascidie *Macroclinum pulmonaria,* aber nur möglicherweise identisch mit der von Lamouroux ebenfalls unter dem Namen *A. pulmonaria* beschriebenen Form.

Von *Alcyonium cydonium* sind 3 verschiedene Formen zu unterscheiden, von denen nach Hartmeyer *A. cydonium* Cuv. eine Synascidie ist; *A. cydonium* L. wie Linné das *A. cotonium* Pall. umtauft, ist wahrscheinlich ein Kieselschwamm; und nur *A. cydonium* Müller könnte eine Alcyoniumart darstellen, die indessen nicht identifizierbar ist.

Aus der Gattung *Alcyonium* scheiden ferner aus:

Alcyonium terminale Q. u. G. = *Lemnalia terminalis* (Q. u. G.).
Alcyonium irregulare Seba = *Janthella flabelliformis* Gray.
Alcyonium arenosum Gmel. = *Flustra arenosa* Ell. u. Sol.
Alcyonium lütkeni Verrill = *Eunephthya glomerata* Verrill.
Alcyonium constellatum Turt. ist nach Hartmeyer ein *Botryllus.*
Alcyonium agaricum Stimpson ist nach Kükenthal ein *Anthomastus,* aber nicht identisch mit *A. agaricum* Linné, das mit *Renilla reniformis* (Pall.) zu identifizieren ist.
Alcyonium asbestinum Pall. = *Briareum asbestinum* (Pall.)

[4] Verh. Ges. Naturf. Fr. Berlin (1916) No. 8.

Ferner scheiden die folgenden in meiner früheren Liste erwähnten Namen aus:

Alcyonium lobatum (Pall.) = *A. digitatum* L.
Alcyonium lobatum Burchardt ist nicht identisch mit *A. lobatum* (Pall.).
Alcyonium norvegicum Kar. u. Dan. = *Parerythropodium norvegicum* (Kar. u. Dan.) (nach Kükenthal).
Alcyonium sollasi Wright u. Stud. ist möglicherweise eine *Sinularia*.
Alcyonium haddoni Wright u. Stud. ist wohl ebenfalls zu *Sinularia* zu stellen.
Alcyonium sarcophytoides Burchardt = *Sarcophytum trocheliophorum* Marenz.
Alcyonium kükenthali Nutting = *Eunephthya spiculosa* Kükth.
Alcyonium carneum Ag. = *Eunephthya rubiformis* (Ehrbg.)

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ILLUSTRATIONEN

Tafel 1

Fig. 1. *Alcyonium pachyclados* Klzgr. Batas Island, Palawan.
2. *Alcyonium digitulatum* Klzgr. Batas Island, Palawan.
3. *Alcyonium equisetiforme* n. n. Sabong, Mindoro.

TEXTFIGUREN

Fig. 1. *Alcyonium pachyclados* Klzgr., Stielskleriten. Vergr. × 200.
2. *Alcyonium pachyclados* Klzgr., Rindenskleriten. Vergr. × 400.
3. *Alcyonium digitulatum* Klzgr. Rinden- und Stielskleriten. Vergr. × 200.
4. *Alcyonium equisetiforme* n. n., Rindenskleriten. Vergr. × 200.
5. *Alcyonium equisetiforme* n. n., Stielskleriten. Vergr. × 200.

TAFEL 1.

NEW ORIENTAL AND AUSTRALIAN ICHNEUMONIDÆ

By R. A. Cushman

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ONE PLATE AND EIGHT TEXT FIGURES

This paper is based largely on specimens received from Prof. C. F. Baker, of the University of the Philippines, together with some from other sources. Most of the new species are from the Philippine Islands, though some few are from other islands, and still others from the Malay Peninsula.

So many genera have been described from the two regions involved, without synoptic keys for distinguishing them, that it is only with the greatest difficulty that species from these regions can be referred to their proper genera. I have found this especially true with the Joppinæ that I have studied. When members of described genera have been located in the material studied, I have constructed synoptic keys to all the species known from the two regions involved.

All of the text figures have been drawn by me, while the plate is from a photograph by Herbert S. Barber, of the Bureau of Entomology.

Genus ACANTHOJOPPA Cameron

Fifteen species of this genus have been described by Cameron, all from India and Borneo and mostly from single specimens, while, as Morley [1] has indicated, *Cryptus praepes* Bingham from the Philippine Islands also belongs here. Morley tabulated thirteen of Cameron's species, omitting *nigrinerva* and *cincticornis*, the latter described in *Anisobas* and later [2] referred by its author to the present genus. Morley suggests that *Acanthojoppa* and *Xanthojoppa* Cameron are perhaps not distinct though easily separated by the strong and complete propodeal carinæ in the former and their lack in the latter. He forthwith includes in the present genus two species, *lutea* and *curtispina*,

[1] Rev. Ichn. Brit. Mus., pt. 4 (1915) 90, footnote.
[2] Journ. St. Br. Roy. Asiat. Soc. 44 (1905) 158.

which he says lack definite areas. However this may be, there is considerable variation in the distinctness of the areolation due to depth of sculpture, and one of the species described below has some of the carinæ practically obliterated. Morley also expressed doubt of the stability of the Cameronian species. In this he may be correct, but it seems hardly possible that individuals differing so markedly as do the ones before me can represent fewer species than listed. These include ten specimens from the Philippine Islands, eight collected by C. F. Baker and two by C. R. Jones. These apparently represent six species, none of which agrees with any of Cameron's descriptions; one, however, is apparently *A. præpes* (Bingham). Not all will agree with the original description of the genus, which is to be expected since the genus was based on a single species, and many purely specific characters were mentioned in the generic description. They fall, however, into three rather distinct groups, worthy perhaps of subgeneric rank.

The following key will serve to separate the six species known from the Philippine Islands:

Key to the Philippine species of Acanthojoppa.

1. Propodeum with distinct apophyses; scutellum convex to pyramidal; pleura and propodeum sculptured; metapleurum not distinctly divided by a carina extending from middle to hind coxæ ..... 2.
   Propodeum without distinct apophyses; scutellum flat or weakly convex; pleura and propodeum polished; metapleurum divided by a sharp carina extending from middle to hind coxæ ..... 5.
2. Scutellum pyramidal and deeply emarginate at summit, nervulus postfurcal; malar space subequal to basal width of mandible; cheeks nearly flat; clypeus flat, not or barely separated; head not contrastingly colored ..... 3.
   Scutellum convex, not emarginate at summit; nervulus interstitial; malar space much shorter than basal width of mandible; cheeks strongly convex; clypeus elevated at base and distinctly separated; head contrastingly colored with yellow and ferruginous.
   A. praepes (Bingham).
3. Flagellum largely black with a distinct white annulus ..... 4.
   Flagellum testaceous at base, black at tip ..... **A. mindanao sp. nov.**
4. Vertex sunken below level of top of eyes; areola strongly longitudinally rugose, open behind; apophyses distinctly behind middle of propodeum.
   A. major sp. nov.
   Vertex about level with top of eyes; areola closed behind, not strongly rugose; apophyses nearly at middle of propodeum.
   A. annulicornis sp. nov.
5. Hind tibia mostly fuscous, the tarsus yellow; areola longer than broad.
   A. polita sp. nov.
   Hind tibia and tarsus nearly uniform pale ferruginous.
   A. mutica sp. nov.

Acanthojoppa major sp. nov.

Female.—Length, 16 millimeters; antennæ, 13. Head subopaque punctate; temples convexly sloping, not nearly as wide as eyes; frons deeply concave with a slight median elevation, the antennal scrobes highly polished below; vertex medially distinctly below level of top of eyes, strongly sloping behind to occipital carina; occiput moderately concave; eyes large, bulging, divergent below, hardly longer than their distance apart below; face nearly flat, rather densely punctate, with a ridge on each side on the inner orbit, which extends obsoletely to the lateral angle of the clypeus, bordered dorsally by a curved ridge that unites at each side with the orbital ridge and extends dorsally as a fine carina nearly to top of eye; clypeus nearly flat, slightly elevated at base medially, at apex broadly rounded with a very inconspicuous median truncature, punctate at base, polished at apex; labrum subangulately rounded at apex; malar space as long as basal width of mandible; cheeks in front view nearly straight; scape distinctly elongate, flagellum rather stout, its basal joint little more than three times as long as thick at apex. Thorax densely punctate, the mesoscutum and scutellum very finely punctate, the pleura coarsely subrugulosely so; notauli obsoletely impressed to middle of mesoscutum; scutellum pyramidal, sinuately tapering toward summit, which is deeply emarginate, its sides densely punctate; propodeum rugose-punctate, basal areas polished, spiracular area open behind, apical transverse carina largely obliterated by coarse sculpture, areola nearly a regular hexagon, open behind, apophyses long and stout and situated distinctly behind middle; legs slender, hind femur reaching nearly to apex of abdomen; longer hind calcarium reaching distinctly beyond middle of basitarsus; basal vein curved; nervulus postfurcal; radius originating at middle of stigma; areolet very narrowly sessile, practically quadrilateral; first brachial cell short and much wider at apex than at base, the basal abscissæ of discoideus and brachius being strongly divergent and the second and third abscissæ of discoideus combined nearly as long as first; intercubitella little more than a third as long as basal abscissa of radiella. Abdomen minutely punctate, opaque; petiole distinctly compressed; postpetiole polished, four times as wide at apex as petiole, sides beyond spiracles divergent; second tergite wider at apex than long, gastrocœli distinct, rather broad, shallow. The area cephalad of each one longitudinally striate; third tergite nearly twice as wide at base as long; ovipositor strongly exserted.

Ferruginous; face, mandibles at base, scutella, and front and middle legs at base paler; abdomen, especially at apex, and mesoscutum slightly darker; flagellum fuscous with an incomplete whitish annulus on joints 6 to 13; legs, except apices of tarsi, testaceous; wings yellow stained; ovipositor sheath fuscous at apex.

Type locality.—Los Baños, Luzon, Philippine Islands.

Type.—Catalogue No. 24035, United States National Museum.

One female collected by C. F. Baker.

Acanthojoppa annulicornis sp. nov.

Closely related to *A. major* sp. nov. and differing from the preceding description of that species as follows:

Female.—Length, 14 millimeters; antennæ, 11. Head polished, mostly impunctate; vertex and top of eyes at about same level; vertex more rounded behind ocelli; occiput rather deeply concave; face with a slight median elevation but without the lateral ridge, sparsely punctate; clypeus hardly elevated at base but separated from face by a fine impressed line, polished throughout with scattered punctures at base, strongly rounded at apex; malar space slightly shorter than basal width of mandible; cheeks in front view distinctly convex. Thorax opaque; pronotum polished, striate along posterior margin and punctate above; mesoscutum densely, finely punctate; scutellum densely punctate above, sparsely so and polished laterally, its sides straight, parallel; mesopleurum obliquely striate-punctate; metapleurum densely punctate; propodeum transversely striate behind, polished and punctate basally; areola separated, the apical transverse carina distinct throughout; apophyses slenderer and situated very nearly at middle; areolet rather broadly sessile; brachial cell not quite so broad relatively at apex. Petiole not compressed; postpetiole three times as wide at apex as petiole, its sides only slightly divergent; second tergite narrower at apex than long, otherwise much as in *A. major;* third tergite fully two-thirds as long as wide.

Ferruginous; head in front and behind eyes, mandibles, pronotum anteriorly and ventrally yellowish, legs as in *A. major* except that hind tibia, except base, and basal two-thirds of basitarsus are fuscous; wings and abdomen as in *A. major.*

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24036, United States National Museum.

One specimen collected by C. F. Baker and one without definite locality collected by C. R. Jones and labeled "Acc. No. 771, Bur. Agr., P. I."

Acanthojoppa mindanao sp. nov.

Immediately distinguishable from the two preceding species by its smaller size and by the lack of the white antennal annulus.

Female.—Length, 12 millimeters; antennæ, 9. Differing from the preceding description of *A. major* sp. nov. as follows: Head polished, practically impunctate above and behind; vertex medially about as high as eyes, convexly sloping behind; occiput rather deeply concave; face with punctures rather dense but shallow, without orbital ridges; clypeus more sparsely punctate at base and more strongly rounded at apex; malar space distinctly shorter than basal width of mandible; cheeks in front view rather strongly convex; scape little longer than thick. Thorax and propodeum sculptured about as in *A. annulicornis* sp nov., but with metapleurum rather distinctly obliquely rugulose; notauli very weak, scutellum tapering toward summit, its lateral margins straight; areola distinctly longer than broad, closed behind, the apical transverse carina strong; apophyses slender, scarcely behind middle; areolet pentagonal, the radial side short; brachial cell with its long sides less strongly divergent, apical two abscissæ of discoideus together much shorter than first; intercubitella barely a third as long as basal abscissa of radiella. Petiole very weakly compressed; postpetiole scarcely three times as wide at apex as petiole, scarcely wider than at spiracles, its sides convex; second tergite hardly as wide at apex as long, gastrocœli not impressed, defined only by difference in sculpture, third tergite distinctly more than half as long as wide at base.

Color as in *A. major,* except that antennæ lack the white annulus, being ferruginous with the apical two-fifths fuscous, and the abdomen is uniformly darker than thorax.

Type locality.—Zamboanga, Mindanao, Philippine Islands.

Other locality.—Davao, Mindanao, Philippine Islands.

Type.—Catalogue No. 24037, United States National Museum.

Two females received from C. F. Baker.

(Cryptus) Acanthojoppa praepes (Bingham).

Cryptus praepes BINGHAM, Ann. & Mag. Nat. Hist. VI 16 (1895) 443.
Microcryptus praepes ASHMEAD, Proc. U. S. Nat. Mus. 28 (1905) 155.
Acanthojoppa praepes MORLEY, Rev. Ich. Brit. Mus., pt. 4 (1915) 19, footnote.

Three specimens are at hand, two from Prof. C. F. Baker taken at Mount Maquiling, Luzon, and Butuan, Mindanao, and the third

collected by C. R. Jones and labeled "Acc. No. 752, Bur. Agr., P. I." All agree so well with Bingham's description that there can be little doubt of the correctness of the determination. Slight variations exist in the height of the scutellar carinæ and the strength of the sculpture.

This species differs from the three preceding species in having the face and pleura striate rather than punctate, the striæ on the face being arcuate and those on the pleura oblique; the clypeus strongly elevated at base and distinctly separated; the malar space much shorter than the basal width of the mandibles; the scutellum convex but not emarginate at the summit; the nervulus interstitial; and in its much smaller size. From the two following species it differs in the convex scutellum; strong propodeal apophyses; distinctly sculptured and subopaque face, pleura, and propodeum; contrastingly colored head; separated clypeus; and almost petiolate areolet.

Acanthojoppa polita sp. nov.

This and the following species differ from all those described above in having the propodeal apophyses obsolete and the pleura and propodeum polished.

Female.—Length, 14 millimeters; antennæ, 11. Head polished throughout except that face is medially arcuately striate above; clypeus polished, strongly elevated at base, the elevation continuous with the median elevation of the face, foveæ very deep, apex broadly rounded, medially subtruncate; labrum exserted; malar space much shorter than basal width of mandible; cheeks in front view straight; vertex impressed below top of eyes, sharply declivous behind; occiput rather deeply concave; eyes large and prominent. Mesoscutum and scutellum opaque; thorax otherwise polished, practically without sculpture, although the propodeum is obsoletely transversely rugulose; notauli sharply defined to middle of mesoscutum; scutellum flat above, the carinæ becoming gradually weaker toward apex, which is subtruncate; lower portion of metapleurum separated off by a sharp arcuate carina between middle and hind coxæ (in the four preceding species this carina is visible only anteriorly); median areas of propodeum narrow, the areola much longer than wide, long horseshoe-shaped and far removed from base of propodeum, lateral abscissæ of apical carina far behind middle abscissa; areolet rather broadly sessile; nervulus antefurcal; first brachial cell nearly parallel-sided and about twice as long as wide. Abdomen opaque, narrow; first tergite stout, polished, petiole nearly

half as wide as postpetiole; second tergite nearly twice as long as wide at base; third and fourth nearly quadrate; ovipositor very briefly exserted; epipleura of middle tergites broad.

Dark ferruginous; face and clypeus yellowish; antennæ black, ferruginous at base and with an incomplete white annulus embracing flagellar joints 8 to 14; wings yellowish hyaline, venation ferruginous; hind tibia except at base black; hind tarsus white, its basal joint fuscous at extreme base, apical joint ferruginous.

Type locality.—Los Baños, Luzon, Philippine Islands.

Type.—Catalogue No. 24038, United States National Museum.

One female received from C. F. Baker.

Acanthojoppa mutica sp. nov.

Male.—Length, 9 millimeters; antennæ, 9. Agrees with *A. polita* sp. nov. in lacking the propodeal apophyses, the low scutellum, and the polished pleura and propodeum, but differs as follows: Face medially punctate, raised laterally above the outer corners of the clypeus; clypeus nearly flat with deep foveæ, apex truncate and with a single row of large punctures; labrum concealed. Thorax about as in *A. polita,* but scutellum distinctly convex and notauli much shorter; median areas of propodeum broader, areola nearly as broad as long, hexagonal, and very close to base of propodeum, lateral abscissæ of apical carina practically continuous with median abscissa; nervulus interstitial. Abdomen broader, second and third tergites punctate at least basally, all beyond second broader than long.

Pale ferruginous, thorax laterally, petiole, and front and middle legs luteous; antennæ black, ferruginous at base and pale in middle; wings only slightly yellow tinged; hind legs ferruginous, the tarsi only slightly paler.

Type locality.—Zamboanga, Mindanao, Philippine Islands.

Type.—Catalogue No. 24039, United States National Museum.

One male received from C. F. Baker.

Genus CTENOCHARIDEA novum

The pectinate claws place this genus in the Listrodromini. In Ashmead's key to that tribe it runs to *Ctenochares* Foerster. No specimen of that genus is available for comparison, but from the description of it and its various synonyms the present genus differs in having the head rather broad behind the eyes, the clypeus rounded at apex, the thorax short and stout, the propodeum without teeth, the wings not clouded at apex, and the areolet obliquely trapezoidal.

Female.—Head transverse, nearly as broad behind eyes as at eyes; temples convex; occiput deeply concave, completely margined; vertex long, the ocelli placed well forward of a line drawn tangent to posterior margins of eyes; frons concave; cheeks broad, weakly buccate but widely visible in front view of head; malar space broad, though much narrower than mandibles; eyes large, strongly convex; face slightly elevated in middle and at sides below; clypeus large, broad, separated from face only weakly by elevation, broadly arcuate at apex, foveæ small; labrum scarcely exserted; mandibles large, strongly curved, bidentate at apex, the teeth large, the upper somewhat the longer; maxillary palpi very long, reaching well beyond apex of front coxæ, second joint triangular; antennæ much shorter than body, slightly incrassate and flattened beneath beyond middle; thorax short and stout; dorsolateral margins of pronotum callose, epomia strong; notauli indicated by the elevation of the prescutum; scutellum large, about as broad at base as long, sides subparallel, rounded at apex, margined to apex, flattened above, elevated and precipitous at apex, separated from mesoscutum by a very deep and narrow furrow; postscutellum and its lateral foveæ foveolate; prepectal carina strong to near top of mesopleura, with a deep angulation at the sternaulus, the latter broadly and weakly impressed; mesopleural furrow foveolate; subalar tubercle with a high, flangelike carina; propodeum rounded above, declivous behind, without spines, areolated only in basal half, areola large, rounded in front, open behind, extending very nearly to base, spiracular area open behind, the spiracles long slitlike; pleural carina complete; legs rather long, slender, the calcaria long, claws pectinate; wings rather short, second abscissa of radius curved at base, areolet oblique trapezoidal, discocubitus weakly curved, with ramellus represented by a slight angulation; nervulus strongly postfurcal; nervellus reclivous, broken near base; abdomen long, narrow, acute at apex, with seven visible tergites, the last as long as sixth; first tergite curved, petiole slightly wider than thick, postpetiole very broad, depressed, spiracles large, elongate; second tergite with large, shallow, subtriangular gastrocœli at outer anterior corners, partially hidden by second tergite; ovipositor exserted.

Type, *Ctenocharidea luzonensis* sp. nov.

Ctenocharidea luzonensis sp. nov.

Female.—Length, 15 millimeters; antennæ, 10; front wing, 10. Head mostly polished impunctate; face and malar space

closely, finely punctate; malar space half as long as basal width of mandible; clypeus obscurely punctate at base, polished at apex; pronotum polished, lower angle obscurely rugulose; mesoscutum and scutellum opaque, reticulate punctate, prescutum anteriorly only weakly sculptured; mesopleurum and metapleurum densely punctate, former with a polished impression in middle; prepectus more finely punctate; basal lateral areas polished, areola coriaceous, propodeum otherwise coarsely rugose-punctate especially in posterior middle; petiole polished, post-petiole coriaceous with a narrow line of large punctures on each side of middle; second and third tergites and fourth except at apex densely, opaquely punctate; apex of fourth and apical tergites polished.

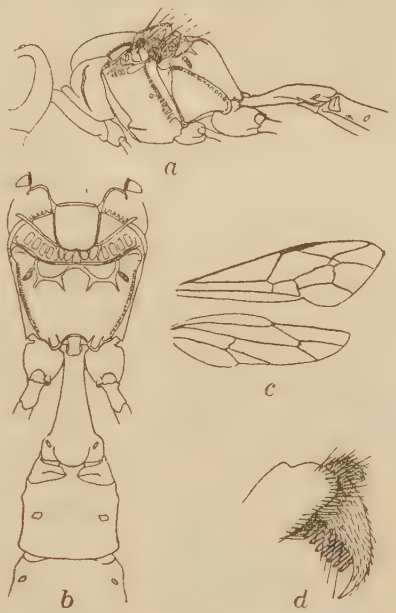

FIG. 1. *Ctenocharidea luzonensis* sp. nov.; *a*, thorax and base of abdomen, lateral view; *b*, portion of thorax, propodeum, and base of abdomen, dorsal view; *c*, wings; *d*, claw of hind tarsus.

Black with yellow markings as follows: Face, except a small median spot, clypeus, mandibles, orbits except an interruption at top of eyes, anterior margin of pronotum except a narrow interruption on each side, dorsolateral margin of pronotum, propleura below, two spots in middle of mesoscutum, apex of scutellum, base of tegulæ, lower half and upper front angle of mesopleurum and a line at its posterior margin, most of metapleurum, a spot on each side of propodeum, base of petiole, apical margins of all tergites, and gastrocœli. Antennæ black with more or less of the upper side of flagellar joints 8 to 19 white; palpi pale; front and middle coxæ and trochanters yellowish, their femora and tibiæ testaceous, more or less fuscous above, and their tarsi fuscous; hind coxæ black without, yellow within, basal joint of trochanter black, apical joint yellow, femur piceous at base and at extreme apex, otherwise testaceous, tibia and tarsus fuscous, calcaria yellow. Wings dilute brownish.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24040, United States National Museum. One female from C. F. Baker.

Genus **PYCNOPYGE** novum

In Berthoumieu's key to the Joppini [3] this runs fairly satisfactorily to the Neotropical genus *Conopyge* Kriechbaumer and, although markedly different in general appearance from that genus, apparently has more in common with *Conopyge* than with any of the Oriental joppine genera described by Cameron and Kriechbaumer. It especially resembles *Conopyge* in the thick head with the rather weakly concave occiput, the propodeal areolation, the broad, medially elevated postpetiole and the suddenly smaller, compressed, and weakly sculptured apical tergites. The medially produced clypeus, distinct notauli and sternauli, less-strongly elevated scutellum, nearly quadrangular areolet, larger fourth tergite, and highly ornamented body form the best characters for distinguishing it from *Conopyge*.

Female.—Head about half as thick anteroposteriorly as broad; occiput rather weakly concave, margined; temples broadly rounded; eyes large, ovate, parallel and entire within; frons shallowly concave, broadly margined laterally and above; face slightly elevated in the middle, flat at sides; clypeus indistinctly separated by elevation from face, flat, nearly as long as broad, roundly prolonged medially at apex, foveæ small; labrum concealed; malar space broad; cheeks convex; antennæ distinctly shorter than body, incrassate beyond middle and rather nearer to the apex than usual, the incrassate portion flattened below and depressed rather than compressed; second joint of maxillary palpi triangular; upper tooth of mandible the larger; thorax ovoid; pronotum with a short strong carina just in front of the humeral angle, the carina terminating above in a distinct angulation; epomia present; notauli and sternauli distinct; prepectal carina strong and complete, reaching nearly to dorsal margin of mesopleura; scutellum convex, margined laterally and apically; propodeum with dorsal face short, posterior face sharply declivous, concave, median longitudinal carinæ behind areola and lateral longitudinal carinæ before the apical carina lacking, areola broad, apical carina at its intersections with the lateral longitudinal carinæ forming on each side a blunt tooth, pleural carina complete, though somewhat obscured by coarse sculpture, spiracle small, elongate oval; wings immaculate; areolet nearly rhomboidal; legs short, stout, hind femur reaching to apex of second tergite; longer calcarium of hind tibia reaching beyond middle of metatarsus; abdomen lan-

[3] Gen. In. fasc. 18 (1904).

ceolate, with seven visible tergites; first tergite nearly as broad at apex as long, petiole rather slender, postpetiole abruptly wider and elevated medially, spiracles well removed from margin, round; this tergite in profile with ventral margin nearly straight, the dorsal margin ascending in a straight line to the summit of the elevation, thence at nearly a right angle to the apex; second tergite coarsely striate-punctate, gastrocœli near base, deep, transverse, separated medially by about half their length; third tergite strongly constricted at base, sculptured like the second; fourth tergite very weakly striate-punctate, tergites 5 to 7 suddenly smaller, polished, compressed, the seventh barely visible; ovipositor exserted, the sheath compressed; black, highly ornamented with yellow; antennæ white annulate.

Male.—Unknown.

Type, *Pycnopyge bella* sp. nov.

Pycnopyge bella sp. nov.

Female.—Length, 9 millimeters; antennæ, 6. Head polished; face sparsely, coarsely punctate; pronotum polished, with a broad foveolate groove along lower posterior margin; mesoscutum opaque, with large, irregularly spaced punctures anteriorly, the notauli foveolate, narrow for half their length, then suddenly broadening with the foveolæ large and transverse; scutellum coarsely pitted dorsally and polished and more or less striate at sides; postscutellum coarsely longitudinally striate, the lateral foveæ strongly foveolate; mesopleurum coarsely, densely punctate, broadly foveolate along posterior margin, a short foveolate groove below the subalar tubercle, a broad ridge outside the sternaulus subtending a foveolate groove; mesosternum densely punctate; metapleurum densely coarsely punctate, divided longitudinally by a strong carina, above which is a foveolate groove; propodeum with basal areas subpolished, areola transverse; rounded in front with a median longitudinal carina anteriorly and several carinæ posteriorly, middle of posterior face coarsely transversely striate, propodeum otherwise densely reticulately punctate.

Black; face, clypeus except apex and dorsal margin, orbits, interrupted narrowly at top of eye and broadening below to include entire cheeks, spots on pronotum dorsally and on ventral angle, on disk of mesoscutum, scutellum, postscutellum, upper anterior angle of mesopleurum and one in front of middle coxa, upper part of metapleurum, each side of propodeum behind, first tergite except postpetiole medially, posterior angles of second and third tergites and second basally at sides, and

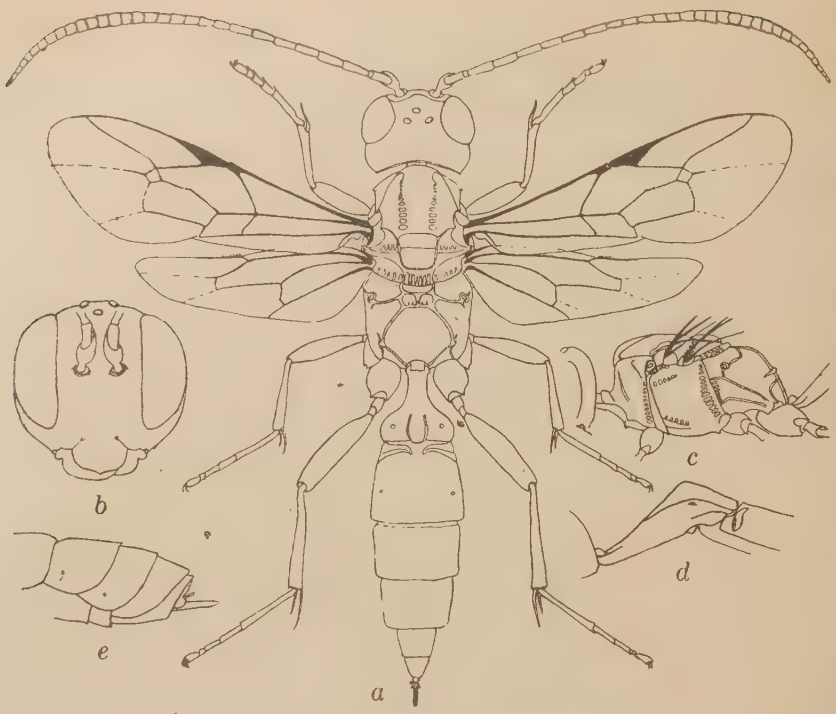

FIG. 2. *Pycnopyge bella* sp. nov., female; *a*, entire insect; *b*, head, front view; *c*, thorax, lateral view; *d*, first abdominal segment, lateral view; *e*, apex of abdomen, lateral view.

apical margins of sixth and seventh tergites yellow; mandibles piceous, slightly yellow near base; antennæ brown at base, paler below; black at apex, the white annulus occupying flagellar joints 8 to 17 incomplete below; palpi, front and middle coxæ and trochanters, and a dorsal spot on hind coxa stramineous; hind coxæ and trochanters reddish piceous; all femora and front and middle tibiæ testaceous; hind tibia above and all tarsi fuscous; wings hyaline, venation fuscous, stigma paler in middle.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24041, United States National Museum. A single specimen from C. F. Baker.

Genus **NESOSTENODONTUS** novum

The acute and edentate mandibles place this genus in the Heresiarchini. In Ashmead's key[4] to that tribe it runs best, because of the missing basal median area and spines of the propodeum and the immargined scutellum, to *Stenodontus* Ber-

[4] Proc. U. S. Nat. Mus. 23 (1900) 20.

thoumieu; and, in spite of the very conspicuous differences, is apparently more closely related to that genus than to any of the other genera included by Ashmead or to any of Cameron's Oriental heresiarchine genera. In the apically rounded clypeus, the distinct sternauli, the straight first tergite, the exserted ovipositor, and the wing venation it is further allied to *Stenodontus*. The posteriorly and dorsally swollen head with very deeply concave occiput; the strongly dentate clypeus; the less-strongly convex face; the longer-jointed, compressed flagellum; the lack of areolation on the posterior half of the propodeum; the longer, slenderer legs; the very inconspicuous, basally located gastrocœli; and the highly ornamented body readily distinguish it from that genus.

Female.—Head as broad behind eyes as at eyes, the temples convexly sloping, nearly as long anteroposteriorly as eye; occiput almost semicircularly excavated, strongly and completely margined; vertex strongly elevated above eye margins, declivous both before and behind, the upper margins of eyes and of posterior ocelli at the same level; cheeks rather weakly convex and, compared with the temples, narrow; frons not at all excavated; face weakly convex; eyes broadly reniform, parallel within; clypeus distinctly separated from face, medially by elevation and laterally by deep oval foveæ, broadly arched basally and rounded apically, the apex margined with a row of conspicous, uneven teeth; labrum not exserted; mandibles strongly curved, very acute; malar space practically obliterated; second joint of maxillary palpus triangular; antennæ about three-fourths as long as body, incrassate and somewhat compressed beyond middle; scape robust, deeply emarginate, basal joints of flagellum slender. Thorax scarcely as wide as head; pronotum with upper margin swollen laterally, epomia absent; notauli obsolete, being represented anteriorly on each side by a small pit; scutellum large, flat, not at all elevated above level of mesoscutum; prepectus strong and complete; sternauli distinct for about half the length of the mesopleura; a broad, low, polished elevation below the wings; propodeum weakly and narrowly set off from postscutellum, gently curved from base to apex, with a broad shallow longitudinal groove from apex of areola to apex, only basal lateral areas and areola defined, the basal median area represented by a single short median carina, spiracles small, about twice as wide as long; wings immaculate, areola trapezoidal, suboblique; legs long, rather slender, hind metatarsus comprising about half of the tarsus, hind coxæ with neither spine nor scopa beneath.

Abdomen with seven visible dorsal segments, narrowly lanceolate, widest behind middle, acute at apex; first segment slightly longer than second, widening rather abruptly at the round spiracles, which are at the apical fourth, in lateral view perfectly straight with the postpetiole but little higher than petiole, suture between tergite and sternite entirely absent or else the sternite is entirely concealed by the tergite; gastrocœli at extreme base of second tergite; lunulæ distinct on second and third tergites, circular; seventh tergite about as long as penultimate; hypopygidium far from apex of abdomen; ovipositor briefly exserted.

Male.—Unknown.

Type, *Nesostenodontus bakeri* sp. nov.

Nesostenodontus bakeri sp. nov.

Female.—Length, 10 millimeters; antennæ, 7.5. Face punctate, coarsely and rugosely so medially, more finely and sparsely so laterally; clypeus polished, with small, scattered punctures; frons and vertex immediately around ocellar triangle coarsely, irregularly punctate; head otherwise polished, impunctate; pronotum polished, weakly punctate anteriorly and crenulate along posterior margin; propleura densely, finely punctate; mesoscutum densely and finely punctate anteriorly, coarsely and sparsely so medially, polished impunctate laterally; scutellum polished, with a few large, very shallow punctures; lateral foveæ of postscutellum foveolate; mesopleura, except rounded elevation under wings, and prepectus densely, coarsely punctate, the former crenulate along posterior margin; propodeum opaque, basal areas sparsely and coarsely punctate; areola coriaceous; median groove coarsely, transversely punctate, almost crenulate; propodeum otherwise coriaceous with more or less distinct punctuation; coxæ, especially hind pair, densely punctate; first tergite polished, postpetiole obscurely punctate; second tergite finely, densely, longitudinally punctate; third to sixth progressively less distinctly punctate; seventh polished, impunctate; ovipositor exserted nearly the length of the seventh tergite.

Black; mandibles, clypeus, inner and posterior orbits, large spots at top of eye, on dorsolateral and anteroventral margins of pronotum, subalar region of mesopleurum, scutellum, metapleurum, and on each side of propodeum posteriorly yellow; apical margin of clypeus and scape testaceous; flagellum brown at base, black at apex, with joints 8 to 20 largely white, a narrow ventral line black; palpi and front and middle legs to near apex of femur white, legs beyond this point testaceous with last tarsal joint

FIG. 8. *Nesostenodontus bakeri* sp. nov., female; *a*, dorsal view; *b*, head, lateral view; *c*, clypeus and mandibles; *d*, first tergite, lateral view.

fuscous; hind coxa and trochanter black to piceous, coxa and the basal joint of trochanter each with a large white spot dorsally, femur testaceous, tibia and base of metatarsus rufofuscous, apical tarsal joint black, tarsus otherwise white; abdomen black; petiole pale testaceous at base, white at apex; tergites 2 to 5 white at apex, narrowly in middle, broadly at hind angles; tergites 6 and 7 dorsally largely white.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24042, United States National Museum.

Described from one female received from C. F. Baker.

Genus **IDIOGNATHUS** novum

I am at a loss to know whether to refer this genus to the Joppini or to the Amblytelini. None of the keys for the separation of the tribes of the Joppinæ furnishes characters that can be interpreted positively for distinguishing these two tribes. In general form it resembles much more closely the Heresiarchini, especially the genus *Nesostenodontus*, described above, but the strongly bidentate mandibles exclude it from that tribe. In almost every other part it is extremely similar to *Nesostenodontus*, especially in the clypeus, the shape of the head, the scutellum, the propodeum, and the venation of the wings. So striking is this similarity that I cannot believe that the form of the mandibles is of real tribal significance in this subfamily. The same may be said of the characters employed for the separation of the Joppini and Amblytelini. In none of the keys to either of the two tribes does it run to anything that is at all related to it; in fact one is constantly in doubt, especially with Berthoumieu's keys,[5] which alternative to follow.

Head very similar in shape to that of *Nesostenodontus* gen. nov. but shorter and slightly narrower behind the eyes than at the eyes; occiput deeply but not nearly semicircularly excavated, completely margined; face medially roundly elevated; clypeus large, arched at base, separated from face, rounded at apex and without apical serrations; eyes broadly reniform; malar space nearly obliterated; mandibles strongly bidentate, dorsal tooth somewhat the longer; second joint of maxillary palpus triangular; antennæ nearly as long as body, in female weakly incrassate beyond middle, the incrassate portion flattened below, but barely perceptibly compressed, in male filiform, not serrate. Thorax scarcely as broad as head; pronotum slightly swollen at humeral angles, epomia distinct; notauli sharply defined for about a third the length of the mesoscutum; scutellum large, nearly flat in female, slightly convex in male; subalar elevation on mesopleurum weak; sternauli short, broad but distinct; lateral foveæ of postscutellum not crenulate; propodeum obtusely dentate posteriorly; basal median area confluent with lateral areas, which are in turn partially confluent with the spiracular areas, none of the longitudinal carinæ reaching the base of the propodeum; areola broadly hexagonal, nearly round anteriorly; apical carina strong; median longitudinal carinæ obsolete or wanting behind areola; spiracles small oval; wings immaculate; areolet

[5] Gen. Ins. fasc. 18 (1904).

practically quadrangular; slightly oblique; legs long, slender, hind metatarsus nearly as long as remaining joints combined. Abdomen in female barely longer than head and thorax combined, narrow, obtuse, with seven tergites visible; in male distinctly longer and with eighth tergite visible; first tergite slightly shorter than second, slightly broader than thick at base and flattened dorsally, gradually broadening from base to spiracles, nearly half as broad at apex as long, in lateral view straight, the dorsal line a gentle curve from base to apex, with a strong carina from dorsal margin of spiracle to base and another from ventral margin of spiracle to apex, spiracles small oval, at apical fifth; second tergite with gastrocœli large, shallow, transverse, distant from base by about their length and from each other by less than their length; lunulæ on second and third tergites small, round; third tergite with large, shallow, transverse gastrocœli at extreme base partially covered by second tergite; hypopygidium retracted; ovipositor exserted.

Type, *Idiognathus balteatus* sp. nov.

Idiognathus balteatus sp. nov.

Female.—Length, 10 millimeters; antennæ, 9. Face finely, sparsely punctate, more densely so in middle, frons below and laterad of ocelli finely, irregularly arcuately striate; head otherwise polished; pronotum polished, slightly roughened on ventral angles; mesoscutum opaque, finely and sparsely punctate; scutellum polished; mesopleurum punctate below, polished above, the sternum punctate; metapleurum punctate; propodeum subopaque coriaceous, polished medially behind; abdomen opaque; second tergite longitudinally striate in its basal two-thirds, second obscurely so in basal middle; apical tergites subpolished.

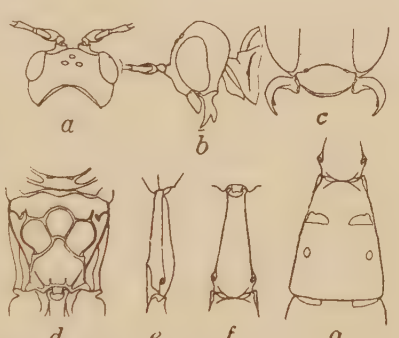

FIG. 4. *Idiognathus balteatus* sp. nov.: *a*, head, dorsal view; *b*, head, lateral view; *c*, clypeus and mandibles; *d*, propodeum; *e*, first abdominal segment, lateral view; *f*, first abdominal segment, dorsal view; *g*, second tergite, dorsal view.

Head black; mandibles, clypeus, and large spot on lower, inner orbits and at top of eyes yellowish white; palpi white; antennæ testaceous at extreme base, black at apex, with a ventrally incomplete white annulus occupying nine to ten joints beyond the sixth flagellar joint; thorax black to piceous dor-

sally, rufous ventrally and laterally except on prothorax; humeral and subalar spots, scutellum, and apex of propodeum yellow; legs pale testaceous; front coxæ and trochanters white; hind tibiæ slightly infuscate, calcaria darker, their tarsi white with apical joint and extreme base of first joint fuscous; wings brownish hyaline, venation fuscous, stigma slightly paler, radix white, tegula brown; abdomen black to piceous, a broad band at apex of second tergite and a large anal spot comprising part of the sixth and seventh tergites yellowish white; other tergites inconspicuously paler at apices; gastrocœli rufous.

Male.—Length, 9 millimeters; antennæ, 9. Aside from the sexual differences mentioned in the generic description, the male differs from the female practically only in having the antennal annulus two joints farther out and the anal spot including only the apical middle of the sixth tergite.

Type locality.—Los Baños, Philippine Islands.

Other locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24043, United States National Museum.

Described from two females and two males received from C. F. Baker, the females from the type locality and the males from Mount Maquiling. The paratypes differ in no essential particular from the type and allotype.

Genus **ELASMOGNATHIAS** Ashmead

The receipt from Prof. C. F. Baker of seven specimens of this genus representing four species furnishes opportunity for further discussion of the genus.

Ashmead was in error in regard to the number of palpal joints. Both the labial and maxillary palpi are normal in this respect, the former being four-jointed and the latter five-jointed. Ashmead also erred in the proportions of the scape, which in his type specimen is not more than two and a half times as long as thick. The notauli are very briefly and shallowly indicated anteriorly. The areola may be longer than wide, as in Ashmead's type, or wider than long, this variation occurring within a species. The nervellus is typically amblyteline, like half of a brace above and straight below the fracture. The mandibles are curiously twisted in such manner as to bring both teeth into the same plane as the face and clypeus.

In addition to the characters mentioned by Ashmead, the following are worthy of note: Head polished, entirely or practically impunctate except face, which is finely, weakly so; malar space long; cheeks, temples, and vertex buccate; ocelli placed

well in front of posterior margins of eyes; occiput margined; face flat above with a curved ridge connecting the antennal foramina; clypeus slightly concave; antennæ nearly as long as body, slightly thickened beyond middle and very attenuate toward apex, the annulus beginning on flagellar joint 6 and including more or less of nine to eleven joints, interrupted below on all but a few joints; thorax and propodeum opaque, the sculpture rather fine; epomia strong; prepectus complete, extending dorsally about half the posterior length of the pronotum; propodeum completely areolated basally and with the petiolar area distinct, but the carinæ defining the middle and posterior lateral and pleural areas obsolete or lacking; wings reaching nearly or quite to apex of abdomen; legs, especially posterior, long, hind femur reaching nearly to apex of abdomen; longer calcarium of hind tibia reaching nearly or quite to middle of basitarsus; abdomen about as long as head and thorax, scarcely as broad as thorax, polished except second tergite and base of third; first tergite distinctly bent, postpetiole distinctly separated; spiracles rather prominent, oval.

Caenojoppa Cameron from the description is very similar in many respects and may have to supersede Ashmead's name. Except that in *Elasmognathias* the propodeum is scarcely impressed medially at base and that the abdomen has the eighth tergite visible, I would be inclined to synonymize the two genera.

Key to the species of Elasmognathias.

1. Propodeum with apophyses obsolete; thorax and propodeum strongly sculptured, the sculpture mostly punctuation; postscutellum longitudinally rugose; prepectus not subemarginate at sternauli, latter weak ..... 2.

   Propodeum with apophyses strong; thorax and propodeum weakly sculptured, the sculpture mostly fine striation; postscutellum not rugose; prepectus subemarginate at sternauli; latter sharply impressed. **E. dentatus sp. nov.**

2. Spiracular area and metapleurum each with a large yellow spot; scutellar carinæ not especially high..... ..... 3.

   Spiracular area and metapleurum entirely black; scutellar carinæ very high and laminate basally..... **E. laminatus sp. nov.**

3. Hind tarsi black at base, the calcaria reddish; scutellum evenly convex. **E. cephalotes (Ashmead).**

   Hind tarsi entirely white, the calcaria black; scutellum distinctly elevated. **E. albitarsis sp. nov.**

Elasmognathias albitarsis sp. nov.

Female.—Length, 12 millimeters; antennæ, 12; front wing, 8. Very closely allied to *E. cephalotes* (Ashmead), differing

practically only as follows: Scutellum distinctly elevated, the highest point before the middle; posterior portion of propodeum with lateral and transverse carinæ practically wanting (in *E. cephalotes* these carinæ are distinct, though weaker than the others); facial black spot shaped like a spade of a playing card, with point down and not reaching clypeus (in *E. cephalotes* this spot is oblong and in the type runs laterally along the clypeal margin; in both species the spot is connected by a narrow line between the antennæ with the frontal black area); outer apical corner of tegulæ black; black of first tergite extending more than halfway to base; hind trochanters largely yellow, femur broadly black at base and apex, with a yellow spot on the outside at apex, tibia largely black with a basal yellowish spot at base confluent with the apical spot of femur and a poorly defined yellowish annulus before the middle but with no dorsal apical spot, tarsus entirely whitish, calcaria black; wings with a distinct brownish stain.

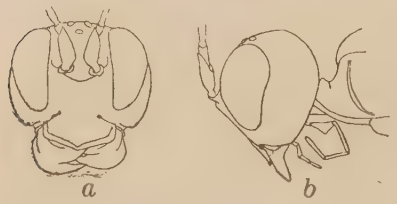

FIG. 5. *Elasmognathias albitarsis* sp. nov., head; *a*, ventrocephalic view; *b*, lateral view.

Type locality.—Mount Banahao, Luzon, Philippine Islands.

Type.—Catalogue No. 24044, United States National Museum. One specimen from C. F. Baker.

Elasmognathias laminatus sp. nov.

Distinct from any known species by the very high, laminate scutellar margins and the arrangement of the color pattern.

Female.—Length, 8 millimeters; antennæ, 8; front wing, 6.5. In structure and sculpture generally very similar to *E. cephalotes* and *E. albitarsis* but with scutellum more rugose and sloping from before the middle, very high and laminate. Color as in *E. cephalotes* except as follows: Facial black spot not connected with frontal; supraorbital spot confluent with postorbital; no mesoscutal spots; postscutellum entirely black; spiracular and metapleural spots lacking; first tergite largely black; yellow of other tergites confined largely to apical angles, except on seventh, which has a large median spot; hind coxæ black with a large yellow spot above; hind femur and tibia without yellow apical marks; hind tarsus and calcaria entirely fuscous.

Type locality.—Iligan, Mindanao, Philippine Islands.

Other locality.—Butuan, Mindanao, Philippine Islands.

Type.—Catalogue No. 24045, United States National Museum. Three females from C. F. Baker.

Elasmognathias dentatus sp. nov.

Distinct from all known species by the strong propodeal spines, striate sculpture of the thorax, and arrangement of color.

Female.—Length, 10 millimeters; antennæ (broken); front wing, 8.5. Face very weakly punctured; thorax and propodeum mostly finely striate; mesoscutum weakly punctate; scutellum elevated, at summit with a more or less distinct median elevation, postscutellum smooth; carinæ weak; prepectus subemarginate at sternauli, latter sharply impressed; propodeum with a strong blunt tooth on each side surmounted by a carina, other carinæ in this region wanting. No black mark on face; eyes entirely surrounded by yellow; thorax black, with broad anterior margin and humeral margin of pronotum, tegulæ, scutellum and postscutellum, lower half and posterior margin of mesopleurum, subalar tubercle, dorsoanterior division of metapleurum (that portion of metapleurum lying between the mesothorax and propodeum), large spot at apex of metapleurum, one on each side of propodeum surrounding and including the spines yellow; front and middle coxæ and trochanters and basal joint of hind trochanter, hind coxa except a large black spot nearly encircling the coxa yellow; front and middle tarsi fuscous; hind tarsi white, narrowly black at base; legs otherwise stramineous to testaceous, the hind femur and tibia more or less piceous at base and apex; calcaria fuscous; wings yellowish hyaline. Abdomen black with petiole, apex of postpetiole, and apices of all other tergites, more broadly at sides, yellow.

Type locality.—Los Baños, Luzon, Philippine Islands.

Other locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24046, United States National Museum. Two females from C. F. Baker.

The paratype is somewhat more heavily sculptured than the type, especially on the mesoscutum, and has the apical elevation of the scutellum less prominent.

CRYPTINÆ

The two Oriental genera treated below run in Schmiedeknecht's Genera Insectorum key to the Mesostenini directly to *Nematopodius* Gravenhorst, and are rather closely related to that genus. The following key will serve to separate the three genera:

Key to the genera of the subfamily Cryptinæ.

1. Antennæ distinctly shorter than body, somewhat thickened toward apex; areolet defined, though often open; nervellus broken below middle; propodeum without any trace of apical carina, spiracles very small, nearly round..... **Nematopodius Gravenhorst.**
   Antennæ nearly or quite as long as body, very slender, filiform or attenuate toward apex; areolet not defined; nervellus broken above middle; apical carina developed at sides; spiracles large, long oval.... 2.
2. Malar space and clypeus very short, latter extending far laterally below eyes; epomia ending above in a sharp tooth; thorax and propodeum polished, impunctate; prescutum gibbous..... **Earrana Cameron.**
   Malar space and clypeus not especially short, latter not especially produced laterally; epomia becoming obsolete above; thorax and propodeum very coarsely punctate; prescutum very low anteriorly. **Esuchonematopodius g. nov.**

Genus **EARRANA** Cameron

Earrana CAMERON, Spolia Zeylanica 3 [40] (1905) 119, pl. B., fig. 3.
Parca MORLEY, Rev. Ich. in Brit. Mus., pt. 2 (1913) 133; Fauna Brit. India, Hym. 3, Ichn., pt. 1 (1913) 301, fig. 102.

I think there can be no doubt of the synonymy of Morley's genus. His type is from the identical locality with Cameron's, and so far as the two generic descriptions treat of the same structures they coincide very closely. There also seems to be very little if any reason to doubt the synonymy of the two genotypes. In Morley's placing of the genus it is without doubt "a remarkably distinct genus" and "by no means a typical Paniscid."

The following generic description includes characters not mentioned by either Cameron or Morley and introduces the hitherto unknown male: Entire body polished, practically without sculpture; head distinctly wider than thorax, transverse, with temples convexly sloping; eyes large, prominent, their inner margins entire, convergent below; clypeus distinctly separated, very broad and extending laterally far under eyes, foveæ touching eyes; mandibles very narrow at apex, the lower tooth obsolete to absent; occiput rather deeply concave, the carina lacking medially; antennæ nearly as long as body, very slender, filiform; maxillary palpi long, all joints slender, slightly deeper than high; pronotum with a strong curved carina along its anterolateral margin, epomia strong, straight, ending above in a sharp tubercle; propleura longitudinally carinate outwardly; notauli deep and complete, meeting before the scutellum, prescutum and lateral lobes strongly convex; scutellum nearly convex, margined at base; sternauli nearly complete, weakly double-

curved; prepectus reaching about halfway up mesopleurum; propodeum extending far beyond base of hind coxæ; basal carina of propodeum strong, apical carina developed laterally; spiracle rather large, long oval; wings long, narrow; stigma very narrow, lanceolate, radius far before middle; second intercubitus entirely lacking, first much reduced, recurrent nearly interstitial; nervulus antefurcal; nervellus strongly reclivous, broken distinctly above middle, upper abscissa perpendicular to cubitella; legs very slender; front basitarsus longer than combined remaining joints; abdomen much narrower than thorax, its basal three segments combined as long as head and thorax combined; first tergite very narrow, with an acute projection on each side at base, spiracles just before middle, prominent; second tergite subequal in length to first, but little wider at apex than at base, constricted near base, with an oblique furrow on each side before the constriction, spiracles slightly before middle, remaining tergites little longer than first two combined; ovipositor sheath about as long as first tergite; valves of the sheath in male long and slender, much as in *Mesochorus*, slightly clavate at their apices.

Earrana dimidiatus (Brullé).

Ischnoceros dimidiatus Brullé, Hist. Nat. Ins. Hym. 4 (1843) 262, pl. 42, fig. 1.

I think there can be no doubt of the propriety of referring this species to *Earrana*.

Earrana malayensis sp. nov.

Female.—Length, 10 millimeters; antennæ, 9; ovipositor, 1.7; front wing, 7. Face below little more than half as broad as vertex; clypeus slightly more than twice as wide as long, apex sinuate medially; malar space about half as long as basal width of mandible; ocellocular line fully as long as width of ocellar triangle; upper end of epomia only slightly more prominent than the rest; depression behind epomia and lower posterior margin of pronotum, lateral depressions of postscutellum, and mesopleural furrow foveolate; first tergite about twice as wide at apex as at narrowest point; second distinctly more than twice as long as wide at apex, its sides parallel beyond spiracles; third two-thirds as long as second; others of rapidly decreasing length; ovipositor sheath slightly longer than first tergite.

Ferruginous; vertex and frons more or less piceous; inner orbits from top of eye, entire face and clypeus, and mandibles

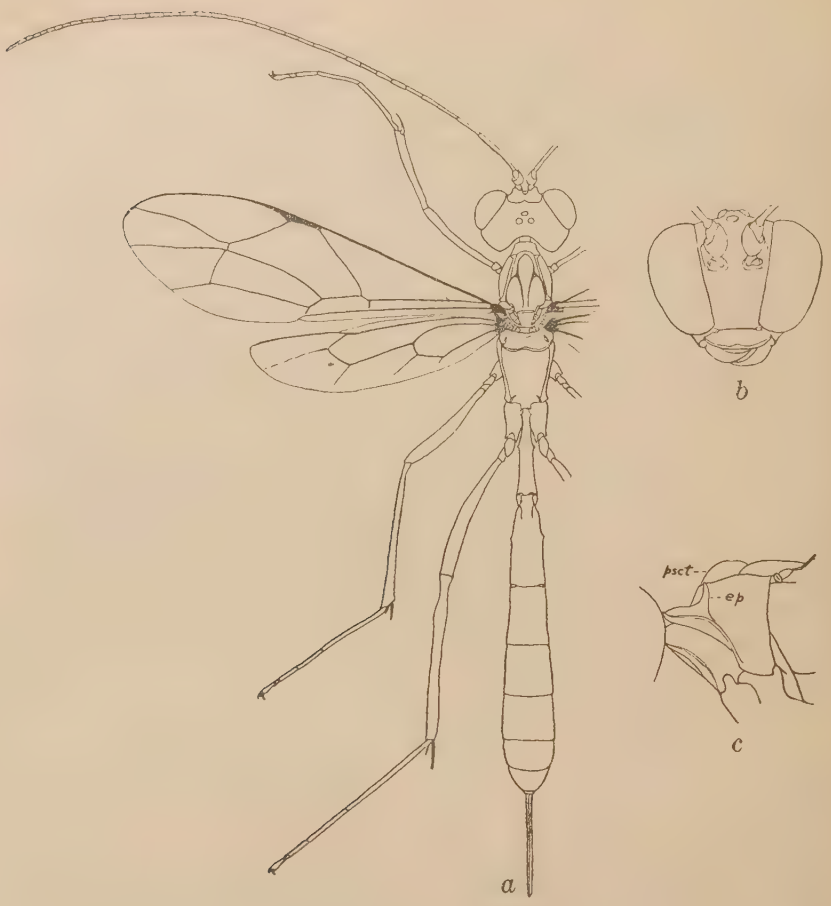

FIG. 6. *Earrana malayensis* sp. nov.; *a*, dorsal view; *b*, head, front view; *c*, thorax, anterior portion, lateral view to show prescutum, *psct*, and epomia, *ep*.

largely yellow; antennæ black, testaceous at base; thorax more or less stained with piceous above, almost stramineous below; legs pale testaceous, front and middle coxæ and trochanters piceous, the tibia and tarsus stramineous, more or less infuscated; wings hyaline, venation brown; abdomen more or less stained with piceous especially toward apex.

Type locality.—Singapore, Malay Peninsula.

Type.—Catalogue No. 24047, United States National Museum. Two females received from C. F. Baker.

Earrana philippinensis sp. nov.

Differing from *E. malayensis* sp. nov. principally in color. The male is selected as the type because of its much better con-

dition, the head of the female being broken off and glued to the double mount and the antennæ mostly missing.

Male.—Length, 13 millimeters. Antennæ stramineous, ferruginous at base; head not at all piceous and with the yellow color not extending above the antennæ; thorax ferruginous above without piceous stains; mesopleura and mesosternum stramineous; upper end of epomia strongly elevated, metapleura vertically wrinkled; stigma much paler than other venation; hind legs not at all piceous or fuscous; sheath nearly as long as first tergite from base to spiracle.

Female.—Agrees very closely with the male.

Type locality.—Philippine Islands, probably Luzon.

Type.—Catalogue No. 24048, United States National Museum.

Described from one male and one female collected by C. R. Jones.

Genus **ESUCHONEMATOPODIUS** novum

Differs from *Earrana* Cameron as follows: Head and thorax, especially the latter, strongly sculptured; posterior two-thirds of temples nearly flat and nearly perpendicular to axis of body; occipital carina obsoletely developed; vertex and frons strongly, sparsely punctate, becoming foveolate at side of frons; eyes weakly convergent below; face and clypeus punctate; latter indistinctly separated medially, not extending far laterally below eyes; thorax very coarsely punctate, becoming striate in middle of mesopleura; epomia fading out above far below dorsal margin of pronotum; front coxæ with a high carinate ridge in front; prescutum declivous anteriorly; lateral lobes each with a deep longitudinal furrow; mesosternum with an acute tubercle before each middle coxa; intercubitus obliterated, recurrent postfurcal; propodeum coarsely punctate, very sparsely so before basal carina; apical carina angulately prominent on each side; hind coxæ coarsely punctate above; abdomen subopaque, first tergite and base of second polished; first tergite nearly linear; spiracles barely protruding; spiracles of second tergite slightly behind middle; ovipositor sheath much longer than first tergite; sheath in male normal, not extending beyond apex of abdomen.

Type, *Esuchonematopodius luzonensis* sp. nov.

Esuchonematopodius luzonensis sp. nov.

Female.—Length, 12 millimeters; antennæ, 12; ovipositor, 3.5; front wing, 9. Face below three-fourths as broad as vertex; clypeus about half as long as wide, broadly rounded at apex; malar space as long as basal width of mandible, ocel-

locular line and width of ocellar triangle equal; first tergite scarcely wider at apex than at spiracles; second more than twice as long as wide at apex; others of rapidly decreasing length; ovipositor sheath nearly twice as long as first tergite.

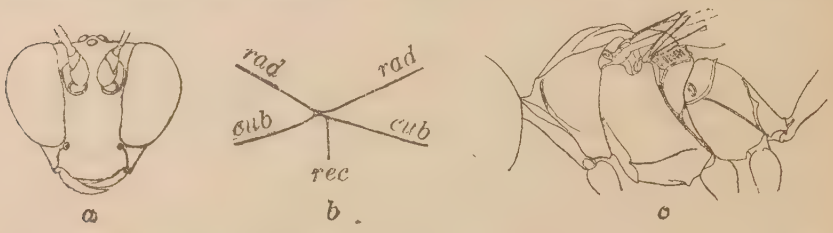

FIG. 7. *Esuchonematopodius luzonensis* sp. nov.; *a*, head, front view; *b*, venation in areolar region; *rad*, radius; *cub*, cubitus; *rec*, recurrent; *c*, thorax, lateral view.

Ferruginous; head and thorax below paler; legs testaceous, front pair and all coxæ paler; wings hyaline, venation brown; antennæ ferruginous.

Male.—Malar space somewhat narrower and antennæ paler than in the female; otherwise much the same.

Type locality.—Philippine Islands, probably Luzon.

Type.—Catalogue No. 24049, United States National Museum.

One female and three males collected by C. R. Jones and one female from Mount Maquiling, Luzon, collected by C. F. Baker.

Genus MANSA Tosquinet

Mansa TOSQUINET, Mem. Soc. Ent. Belg. 5 (1896) 209.
Colganta CAMERON, Ent. 35 (1902) 20.

This peculiar genus has much in common with the Palæarctic *Megaplectes* Foerster. The second joint of the maxillary palpus is even larger than in *Megaplectes* though not triangular; the head is of much the same form as that of *Megaplectes* though all of its features are exaggerated, as is frequently found to be the case in tropical genera closely related to genera of more northern range; the propodeum is similar but shorter and more strongly concave; the abdomen is shorter with the apical tergites relatively smaller; the venation, except for the unusual shape of the areolet, is very similar; and the long calcaria and large apical tarsal joints are almost duplicated in *Megaplectes*. In the new allied genus *Ceratomansa*, described below, the strong notauli and sternauli, almost lacking in *Mansa*, are almost exactly as in *Megaplectes*.

Seven specimens referable to this genus are at hand. Six from the Philippine Islands represent two closely related species,

apparently distinct from any of the described Oriental or Australian species. In a key that I have constructed from the descriptions of all of the species from these two regions the females of both species run to *M. fulvipennis* (Cameron) and the males to *M. volatilis* (Smith). Cameron's species, however, is from northern India and, moreover, is very meagerly described, the entire description being composed of the characters mentioned in a key to five species from that locality and a few others mentioned later in the description of *M. latiscutis* (Cameron). Cameron's description of the propodeal areolation of *M. fulvipennis* is rather obscure, but it is apparently more nearly complete than in the two Philippine species. (*Cryptus*) *Mansa volatilis* (Smith) from Mysol is described in the female and is said to have the antennæ black with a pale annulus, with which the present males agree but not the females. The seventh specimen is a female from Siam. It is very distinct by reason of its entirely black thorax and very dark wings.

The key mentioned above with the three new species inserted is reproduced below. It is based very largely on color because many of the species, notably Smith's and Cameron's northern Indian species, are described practically only by color.

Key to the Oriental and the Australian species of Mansa.

1. Black or largely black ..... 2.
   Thorax black; head, abdomen, and legs rufous to ferruginous; wings very dark ..... **M. bicolor sp. nov. (Siam.)**
   Ferruginous, fulvous or flavous, sometimes marked with black ..... 3.
2. Wings fuscous; second tergite fuscoferruginous; basal half of antenna ferruginous; 16 millimeters, ovipositor 6.
   M. funerea Turner. (Indo-China.)
   Wings not fuscous; abdomen black with apical two tergites white-marked; antennæ black with joints 8 to 17 white beneath; 15 millimeters, ovipositor 4 ..... **(Colganta) rufipes** (Cameron). (Borneo.)
3. Mesoscutum more or less black or blackish ..... 4.
   Mesoscutum ferruginous ..... 5.
4. Hind femora, tibiæ, and tarsi black; 15 millimeters, ovipositor about 3.
   (Colganta) nigro-maculata (Cameron). (Borneo.)
   Hind femora and tibiæ red; 15 millimeters.
   M. conformalis Tosquinet, female. (Java.)
5. Areolet not distinctly narrowed below, intercubiti straight; 12 millimeters, ovipositor 2.
   (Colganta) tuberculata (Cameron).[6] (Northern India.)
   Areolet narrowed below, the intercubiti oblique ..... 6.
6. Hind tarsi not black, at most only slightly annulated with black or with apical joints only black ..... 7.
   Hind tarsi black ..... 13.

[6] The characters used constitute the entire description of this species.

7. Wings dark violaceous; antennæ blackish with dark fulvous annulus; 16 millimeters, male only.
(Colganta) **fulgidipennis** (Cameron).[7] (Northern India.)
Wings hyaline, suffused yellow or fulvous, rarely with a fuscous cloud behind stigma or at apex ..... 8.
8. Antennæ flavous or ferruginous at base, broadly black at apex..... 9.
Antennæ black, yellow annulate ..... 11.
9. Antennæ without white annulus; scutellum narrowed at apex with gradual slope; wings without a cloud; 12 millimeters, ovipositor 4.
(Colganta) **fulvipennis** (Cameron).[7] (Northern India.)
[The two Philippine species described below run here in the female, but have the propodeum less completely areolated. They can be separated from each other as follows:]
9*a*. Clypeus with a median, apical tooth; face very coarsely rugose-punctate laterally; frons coarsely punctate; scutellum with rather coarse, separated punctures; areolet not nearly twice as long beyond recurrent as before; inner spur of hind tibia barely reaching to middle of basitarsus ..... **M. bakeri** sp. nov.
Clypeus without an apical tooth, medially narrowly impressed and emarginate; face at sides sparsely punctate; frons finely punctate; scutellum with fine confluent punctures; areolet about twice as long beyond recurrent as before; inner spur of hind tibia reaching distinctly beyond middle of basitarsus.
M. luzonensis sp. nov.
Antennæ tricolored with a whitish annulus..... 10.
10. Apical half of wing infumate; scutellum triangular; 17 millimeters.
M. pulchricornis Tosquinet, female. (Java and northern India.)
Wings entirely hyaline; scutellum broadly rounded at apex, apical slope abrupt; 17 millimeters, ovipositor 3.
(Colganta) **latiscutis** (Cameron). (Northern India.)
11. Costa black..... **M. conformalis** Tosquinet, male only. (Java.)
Costa ferruginous ..... 12.
12. Wings without fuscous cloud behind stigma, which is entirely ferruginous; 7 lines; female only.
(Cryptus) **volatilis** (Smith). (Mysol.)
[The two Philippine species described below run here in the male, but the females lack the white antennal annulus. The males can be separated by the key given under couplet 9*a* above.]
Wings with fuscous cloud behind stigma, which is margined with black.
M. volatilis subsp. **fumipennis** Turner. (Northern Queensland.)
13. Tibiæ black..... 14.
Tibiæ at most black at apex..... 15.
14. Length 12 millimeters; male only.
(Colganta) **tibialis** (Cameron).[8] (Northern India.)
Length 17 millimeters; ovipositor 5; female only.
(Colganta) **annulicornis** (Cameron). (Borneo.)

[7] The characters used in the key constitute the entire original description. This species was further described by Cameron in his description of *Colganta latiscutis*.

[8] The characters used constitute the entire description of this species.

15. Hind femur, apex of tibia and tarsus black; 12 millimeters; ovipositor 2 ..... (Colganta) varicornis (Cameron). (Borneo.)
Hind femur not black ..... 16.
16. Wings apically infumate; 6⅔ lines; male only.
(Cryptus) sicarius (Smith), male (=*Cryptus tarsatus* Smith, according to Cameron).[9]
Wings not apically infumate; 12 millimeters; male only.
(Colganta) tarsalis (Cameron).[8] (Northern India.)

Mansa bakeri sp. nov.

Female.—Length, 18 millimeters; antennæ, 18; ovipositor, 4.5; front wing, 15. Frons with sparse, obscure, large punctures on a granular surface, medially shallowly canaliculate; face medially slightly elevated, densely punctate, laterally irregularly transversely rugose; clypeus finely punctate, less densely so than middle of face, flattened, truncate at apex with a small median tooth; malar space longer than basal width of mandible; cheeks nearly straight; temples sparsely punctate; eyes prominent, parallel within. Thorax opaque above, subpolished laterally; pronotum densely punctate above, rugulose in the depression; mesoscutum and scutellum, the latter at sides as well as dorsally, very densely finely punctate and clothed with blackish hairs; notauli entirely absent; scutellum elevated, rounded behind in both dorsal and lateral views; mesopleurum shining, obscurely rugulose-punctate anteriorly, more strongly so ventrally; prepectus punctate, rugulose anteriorly; mesopleural furrow foveolate; sternauli broad, rugulose; sternum minutely punctate; metapleurum punctate anteriorly, merging into coarse vertical rugosity posteriorly, with posterior ventral corner separated by a sharp, curved carina; propodeum opaque granulate with more or less obscure rugosity, especially on posterior face, and with the rugosity of the metapleurum extending onto the lower posterior angle, median carinæ obsolete throughout, lateral carinæ obsolete anteriorly, strong posteriorly, basal carina entirely lacking, apical carina very strong at sides, wanting in middle, the propodeum medially impressed nearly its entire length, distinctly separated from metapleura only anteriorly, spiracle very long, occupying fully half the length of the space between base of propodeum and apical carina; hind coxa distinctly punctate, the tibia and tarsus equal in length; inner calcarium of hind tibia reaching barely to middle of basitarsus; areola much broader on radius than

[9] The female of *sicarius* Smith will run here if the tarsi are black, but the original description says nothing on this point.

on cubitus, first intercubitus strongly oblique, second nearly vertical, recurrent somewhat before the middle; nervellus strongly reclivous but not sharply broken. Abdomen smooth, without sculpture; postpetiole nearly or quite half as wide as entire first tergite is long, with a longitudinal furrow between the spiracles, flanked on either side by a shorter one.

Ferruginous, the head in front and thorax laterally slightly paler; basal three-fifths of antennæ fulvous, apex black; palpi flavous; legs testaceous, apices of hind tibia and tarsal joints slightly fuscous, apical joint rufous; wings uniform yellow hyaline; ovipositor sheath yellow.

Male.—Length, 12 millimeters; antennæ, 11; front wing, 12. Differs from female principally in the color of the antennæ and hind legs, the scape and pedicel being flavous, the flagellum black with the basal joints fulvous below and a pale annulus about the middle, the hind tibia with the apical half black, and the tarsus pale yellow; the sculpture is somewhat weaker.

A paratype female is like the type except in being somewhat smaller, in having the postpetiole slightly narrower, and the sculpture, especially of the propodeum and metapleurum, weaker.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24050, United States National Museum.

Described from the above three specimens all received from Prof. C. F. Baker. The paratype female is from Los Baños, Luzon.

Mansa luzonensis sp. nov.

Closely allied to *M. bakeri* sp. nov. and differing principally as follows:

Female.—Length, 14 millimeters; antennæ, 14; ovipositor, 3.5; front wing, 12.5. Frons minutely, granularly punctate; sides of face only obscurely punctate; clypeus narrowly impressed and emarginate medially at apex; temples impunctate; pronotum as in *bakeri* but the rugulosity very weak; pubescence of mesoscutum and scutellum cinereous instead of black; mesopleurum and prepectus punctate but scarcely at all rugulose; sternauli punctate; metapleurum and propodeum less strongly rugose; carina of metapleurum nearly straight; propodeal carinæ on the whole more distinct but the apical carina and apical abscissa of lateral carina weaker; hind tarsus slightly longer than tibia, inner calcarium reaching distinctly beyond middle of basitarsus; recurrent vein at about the proximal third of areolet; first tergite slender, postpetiole not nearly half as wide as segment is long.

Colored like *bakeri* but with hind tibia and tarsal joints not black at apex, the tarsus distinctly paler than tibia.

Male.—Length, 10.5 millimeters; antennæ, 11; front wing, 10.5. Differs from female in color of antennæ and hind legs, the antennæ being black, pale at base and medially annulate, the hind tibia having its apical two-thirds black, and the tarsus being yellow with the basal joint narrowly black at base.

A paratype female is slightly smaller than the type.

Type locality.—Philippine Islands, probably Luzon.

Type.—Catalogue No. 24051, United States National Museum.

Described from the above three specimens, the type labeled "Acc. No. 771, Bur. Agr., P. I., collected by C. R. Jones;" the allotype male from Los Baños, Luzon (*Baker*); and the paratype female from Mount Maquiling, Luzon (*Baker*). The paratype is returned to Professor Baker.

Mansa bicolor sp. nov.

Very distinct by reason of its black thorax, red head, abdomen, and legs, and very dark wings. It is apparently closest to *funerea* Turner, which, however, has only the second tergite reddish and the ovipositor relatively shorter.

Female.—Length, 19 millimeters; antennæ (extreme tips gone); ovipositor, 8; front wing, 16. Frons finely granulate, medially punctate and canaliculate; face medially elevated and coarsely, densely punctate, laterally reticulate-rugose; clypeus distinctly separated from face by elevation, coarsely and sparsely punctate, broadly truncate at apex and with the margin medially slightly reflexed; malar space distinctly longer than basal width of mandible; cheeks coarsely punctate, the punctuation gradually weaker dorsally until on posterior slope of vertex it disappears entirely. Thorax coarsely sculptured; pronotum dorsally and mesoscutum densely punctate, scutellum less densely so and polished; pronotum below, mesopleurum, metapleurum, and propodeum reticulate-rugose; propleura polished, sparsely and obsoletely punctate; mesosternum more finely and less densely punctate than mesoscutum; notauli entirely wanting, sternauli practically so; scutellum elevated, margined only at extreme base; propodeum with lateral and pleural carinæ complete, the first curving forward in middle nearly to base, no traces of basal carina present, lateral especially strong above spiracle; areolet much broader on radius than on cubitus, first intercubitus very strongly oblique and curved, second nearly perpendicular and straight, second recurrent much nearer base than apex;

nervellus strongly broken, lower abscissa strongly oblique, upper nearly perpendicular. Abdomen polished, second tergite very finely punctate; first tergite a third as wide at apex as long, its surface smooth, without furrows or other sculpture.

Thorax, coxæ, tegulæ, and apical half of antennæ black; head, basal half of antennæ, and legs ferruginous to testaceous; ovipositor black, sheath pale ferruginous; wings very dark.

Type locality.—Trong, Lower Siam.

Type.—Catalogue No. 24052, United States National Museum. One female, W. L. Abbott, collector.

Genus CERATOMANSA novum

This genus is closely allied to *Mansa* Tosquinet; the most striking differences are indicated in the following key:

1. Frons shallowly concave, unarmed; vertex deeply concave; antennæ stout, especially beyond middle, apex blunt; maxillary palpi very long, reaching far beyond apex of front coxæ; notauli practically wanting; sternauli weak; basal carina of propodeum wanting; legs stout, hind tarsi not white annulate ..... **Mansa** Tosquinet.

   Frons deeply concave, with a strong median compressed horn; vertex nearly level with top of eye; antennæ slender, barely thickened beyond middle, attenuate at apex; maxillary palpi barely reaching apex of front coxæ; notauli and sternauli strong; basal carina of propodeum strong; legs, especially the tarsi, slender, hind tarsi black with third and fourth joints white ..... **Ceratomansa g. nov.**

In addition to the characters given in the key, *Ceratomansa* differs from the three species of *Mansa* described on preceding pages as follows: Slenderer; head and thorax less strongly sculptured; face impressed on each side of middle; malar space not longer than basal width of mandible; prepectal carina complete; speculum partly striate; apical tarsal joint much shorter than third; areolet much smaller, scarcely half as long on radius as basal abscissa of radius, second recurrent beyond middle; discocubitus slightly angulate; nervulus antefurcal; postnervulus strongly broken; basal abscissa of discoideus much more than twice as long as nervulus.

Type, *Ceratomansa prima* sp. nov.

Ceratomansa prima sp. nov.

Female.—Length, 15 millimeters; antennæ, 18; ovipositor, 5; front wing, 14. Temples, cheeks, face, and clypeus coriaceous, last two opaque and sparsely punctate; frons subpolished and somewhat irregularly rugulose; vertex punctate; upper inner orbits swollen; vertex precipitous behind; occipital carina very

strong, especially medially; ocellocular and postocellar lines equal, diameter of lateral ocellus slightly shorter; eyes large, bulging, parallel within, much longer than width of face; malar space barely as long as basal width of mandible; clypeus distinctly separated from face, as long as interfoveal line, broadly truncate at apex; mandibles short, teeth blunt, upper larger and very slightly longer than lower; apical joint of maxillary palpus only slightly shorter than fourth. Thorax largely finely densely punctate; pronotum rugose below, epomia strong but not reaching upper margin; scutellum shining, sparsely punctate, margined only at base, fovea with several longitudinal rugæ; mesopleurum largely rugose above, speculum elevated and polished only behind, the anterior part embraced by the rugosity; sternauli incomplete behind but deep and partly foveolate, the posterior end curving suddenly upward; propodeum punctate before and reticulate-rugose behind basal carina, weakly concave on posterior slope, pleural carina obsolete, being largely replaced by a foveolate groove, apical carina prominent laterally; coxæ punctate, especially posterior pair. Abdomen beyond first tergite very finely shagreened; first tergite polished, petiole slender, tergite and sternite completely fused, postpetiole at apex about three times as wide as narrowest part of petiole, spiracles slightly nearer to each other than to apex, petiole flattened above, the flattening becoming a slight impression between the spiracles; ovipositor slender.

Ferruginous; head black, inner orbits, face except impressions, cheeks, indistinct line on posterior orbits, clypeus, mandibles except apices, and palpi largely whitish; antennæ black with a ventrally incomplete white annulus on flagellar joints 7 to 14; upper margin of pronotum, tegulæ, wing bases, scutellar carinæ, prepectus and subalar tubercle, and posterior margin of mesopleurum luteous; legs testaceous, apical tarsal joints on all legs, basal two joints of hind tarsus, and apices of its tibia and femur black; wings hyaline, slightly stained with yellow, venation black, stigma white at extreme base; tergites 2 and 3 slightly stained with blackish at sides; ovipositor sheath black.

Type locality.—Shoalhaven, New South Wales.

Type.—Catalogue No. 24053, United States National Museum. One female (G. W. F., 1895).

Genus HEMIGASTER Brullé

Only five species from the Oriental and Australian Regions have been described in this genus; and one of these, *H. jacobsoni*

Szépligeti from Java, is certainly misplaced. It properly belongs in the genus *Syrites* Tosquinet, where it is very closely related to the Philippine (*Astomaspis*) *Syrites metathoracica* (Ashmead). None of the other four species is available for study, but the two new species, one from Singapore and one from the Philippine Islands, described below, are apparently distinct from either, as indicated by the following key which includes all six species:

Key to the Oriental and the Australian species of Hemigaster.

1. Luteous, vertex and back of abdomen red.
   H. luteus Brullé. (Australia.)
   Ferruginous ..... 2.
2. Notauli present ..... 3.
   Notauli absent ..... 5.
3. Hind tarsi pale ..... **H. carinifrons** Cameron. (Assam.)
   Hind tarsi black ..... 4.
4. Second tergite with a broad black band at base; sides of face and of vertex brown ..... **H. fasciatus** Brullé. (East Indies.)
   Immaculate ferruginous ..... **H. malayensis** sp. nov. (Singapore.)
5. Mesoscutum with three fuscous marks; wings apically infuscate.
   H. insularis Roman. (Philippine Islands.)
   Mesoscutum immaculate; wings yellowish hyaline, paler at apex.
   H. bakeri sp. nov. (Philippine Islands.)

Hemigaster malayensis sp. nov.

Female.—Length, 9 millimeters; antennæ, 8.5; front wing, 7.5. Vertex laterally with large, rather sparse punctures, which merge anteriorly into the irregular rugosity of the sides of frons; interocellar space opaque, without distinct sculpture; margined only at sides, the carinæ merging into the general sculpture above; median horn thick and canaliculate on dorsal edge, bilobed at apex; face and clypeus reticulate-rugose, more coarsely so at sides, elevated in middle; clypeus without a median apical tooth; cheek and lower temple transversely rugose, this fading out to fine, rather dense punctuation at the middle of the eye. Pronotum rather finely punctate above, coarsely foveolate in ventral angle and along anterior and posterior margins; mesoscutum rather finely, very densely punctate, notauli distinct to middle, prescutum with a median groove anteriorly; scutellum sculptured like the mesoscutum, tapering to the very narrow apex, and with strong lateral carinæ extending to the apex; mesopleurum densely rugulose with an oblique, transversely striate area in the middle; anterior and posterior furrows foveolate; prepectal carina approaching anterior margin gradually;

sternaulus deep, complete, and strongly foveolate; mesosternum with a rounded tubercle in front of mesocoxæ but with no ridge running forward from these; metapleurum rather finely rugulose-punctate; propodeum irregularly reticulate-rugose at sides, subpolished and transversely striate medially, carinæ strong and thin, especially the apical carina which is high and flangelike but without distinct apophyses, propodeal area concave, separated from posterior lateral only by difference in sculpture; discocubitus broken; nervellus broken nearly at a right angle; hind coxa without a carina on its exterior dorsal margin; inner calcarium of hind tibia reaching distinctly beyond middle of basitarsus; abdomen finely, densely punctate, first tergite polished at base and with the median dorsal carina distinct and well separated to base; third tergite strongly rounded at apex; ovipositor as long as second tergite.

Ferruginous with short, golden, appressed pubescence; face stramineous; flagellum blackish, brownish at base, especially beneath, with an incomplete whitish annulus dorsally occupying joints 4 to 8; wing slightly smoky, costa and stigma light brown, other veins blackish; legs testaceous; front and middle coxæ and trochanters stramineous; hind femur and tibia at apex, hind tarsus entirely, and apical joints of other tarsi black; calcaria reddish; ovipositor sheath black.

Male.—Very similar to female but with the antennal annulus smaller and less distinct and the stigma largely blackish.

Type locality.—Singapore, Malay Peninsula.

Type.—Catalogue No. 24054, United States National Museum.

Described from two females and two males, all received from C. F. Baker.

There is considerable variation in size, the largest female, the type, being 9 millimeters long and the smallest male, paratype *b*, only 5.5.

Hemigaster bakeri sp. nov.

Female.—Length, 12 millimeters; antennæ, 10; front wing, 9. In addition to being larger, differs from *malayensis* as follows: Vertex laterally densely reticulate-punctate, the sides of the frons more coarsely but not differently sculptured; interocellar space with a few large punctures; frontal concavity margined nearly to middle above, the carina high and sharp and sending a branch carina dorsally where it begins to arch over the concavity; median horn very thin on dorsal edge, not

bilobed at apex; face at sides and clypeus coarsely transversely rugose-punctate, more finely so toward middle and with a narrow unsculptured median line; clypeus with a small median tooth at apex; cheeks with coarse, separated punctures becoming smaller and sparser on temples where they gradually disappear. Pronotum coarsely punctate above, otherwise as in *malayensis;* mesoscutum more coarsely punctate, notauli and median groove of prescutum wanting; scutellum sculptured like mesoscutum, narrow at apex, obscurely margined only at base; mesopleurum coarsely punctate, the striate area of *malayensis* here replaced by a smooth polished area, anterior furrow obscure, not foveolate; prepectal carina bending sharply toward anterior margin shortly above level of ventral angle of pronotum; sternaulus deep anteriorly but fading out shortly behind middle of pleurum, not foveolate; mesosternum with a ridge running forward from the antecoxal tubercle; metapleurum coarsely rugose-punctate; propodeum medially punctate, carinæ mostly rather weak but with distinct apophyses that are fully as high as their basal width, propodeal area only slightly concave, separated from posterior lateral by distinct carinæ; discocubitus not broken; nervulus not triangularly broadened at its lower end; nervellus broken at a very wide angle, hind coxa with a high, sharp carina on its exterior dorsal margin; inner hind calcarium barely reaching middle of basitarsus. Abdomen more coarsely punctate, especially on petiole, which is polished only at extreme base, the median dorsal carinæ almost contiguous on the petiole and nearly obliterated by the coarse sculpture; third tergite broadly rounded at apex; ovipositor as long as second tergite.

Colored like *malayensis* except that the wings are yellowish hyaline, the hind femur not black at apex, the hind tarsus yellow with the apical joint reddish, and the ovipositor sheath reddish at base.

Male.—Differs from female practically only in having the basal two-thirds of the antennæ ferruginous with only the faintest indication of the annulus.

Type locality.—Los Baños, Luzon, Philippine Islands.

Other localities.—Mount Maquiling and Mount Banahao, Luzon, Philippine Islands.

Type.—Catalogue No. 24055, United States National Museum.

Described from three females and two males, all received from C. F. Baker. Only slight variation in size is displayed by the type series.

Genus ROTHNEYIA Cameron

Three species have been referred to this genus by Cameron, all from India, while Schmiedeknecht records one of them also from Java. The second species described, *annulicornis* Cameron, differs so markedly in structural characters from the others that one wonders, not having examined it, if it is properly placed in the genus. These differences are brought out in the following key to the species. The new species tabulated and described below is apparently typical of the genus.

Key to the species of Rothneyia.

1. Third tergite not toothed at apex; flagellum white-annulated; separation between second and third tergites obscure; scutellum without teeth, simply margined ..... **R. annulicornis** Cameron.
   Third tergite toothed at apex; flagellum not white-annulated; separation between second and third tergites distinct; scutellum with teeth at apex ..... 2.
2. Petiole ferruginous ..... **R. wroughtoni** Cameron.
   Petiole black ..... 3.
3. Antennæ longer than body ..... **R. fortispina** Cameron.
   Antennæ shorter than body ..... **R. insularis sp. nov.**

Rothneyia insularis sp. nov.

Male.—Length, 6 millimeters; antennæ, 4.5; front wing, 4.5. Head transverse, in front view roundly triangular, temples slightly convex, sharply sloping; frons with large, separated punctures, the middle narrowly polished, impunctate; vertex very sparsely punctate; face densely, confluently punctate, becoming striately so in middle; clypeus sparsely punctate, not separated from face by a furrow but by difference in sculpture, longer than face, gently convex and rather sharply rounded at apex; malar space two-thirds as long as basal width of mandible; eyes convergent to level of antennæ, thence parallel, slightly sinuate above antennæ; antennæ distinctly shorter than body, basal three joints of flagellum subequal and each scarcely longer than scape, the flagellum attenuate at apex; postocellar and ocellocular lines equal and distinctly longer than diameter of ocellus. Thorax opaque dorsally and ventrally, shining laterally; pronotum polished with a few rugæ posteriorly and sparsely punctate above, epomia distinct but fading out below dorsal margin; mesoscutum densely punctate, notauli distinct anteriorly, lateral lobes flanked by a deep groove laterally; scutellum rugose, posterior angles very high and prominent, apical slope abrupt, with a few longitudinal rugæ, lateral areas polished,

foveolate above and below; mesopleurum polished in middle, rugulose-punctate dorsally and anteriorly, mesopleural furrow foveolate, prepectal carina very sharp, curving backward below the front wing to join the carinate dorsal margin of the pleurum; sternauli complete, deep and broad anteriorly; sternum densely punctate, median furrow very broad and deep; propodeum and metapleurum irregularly rugose; basal area confluent; spiracle round, situated on a raised area; apophyses very prominent; pleural carinæ and costellæ obscured by sculpture; nervulus interstitial; areolet higher than long, intercubiti slightly convergent above; bullæ large, second intercubitus largely hyaline; nervellus strongly inclivous, broken at lower fourth. Abdomen coarsely reticulate-rugose; first tergite as wide at apex as long, median carinæ convergent beyond middle, not attaining the apex but becoming obscured by the sculpture, spiracles subtuberculate; second and third tergites separated by a distinct suture, third with prominent apical angles.

Black; antennæ toward base and palpi brownish; front and middle legs brownish piceous, their tibiæ and tarsi pale; hind legs darker; wings hyaline, immaculate.

Type locality.—Los Baños, Luzon, Philippine Islands.

Type.—Catalogue No. 24056, United States National Museum.

Described from one male collected by C. F. Baker.

Genus **SYRITES** Tosquinet

Syrites Tosquinet, Mem. Soc. Ent. Belg. 10 (1903) 117.
? *Camptolynx* Cameron, Berl. Ent. Zeit. 55 (1910) 252.

I am somewhat doubtful of the synonymy of *Camptolynx*. Cameron states that in the male this genus has the spines on the fourth tergite. In *Syrites* they are on the third. Aside from this Cameron's description is very like *Syrites*, and it may be that he was mistaken as to the location of the spines or that there is variation within the genus in this respect.

Acanthoprymnus Cameron, from South Africa, synonymized by Schmiedeknecht with *Syrites*, seems not to be the same genus. It is described in the female as having spines on the third tergite, a character not found in the female of *Syrites*.

The peculiar structure of the abdomen in the male and the marked sexual antigeny have led to the description of species properly placed here in no less than seven genera. All are from the Australian and Oriental Regions.

The following key is based on the descriptions of all of the Australian and Oriental species that I have been able to identify

as probably belonging to this genus and material of two species from the Philippines. Because the color has as a rule been more carefully described, practically all of the characters used are color characters. It should be noted, however, that the color, especially of the thorax, is variable in both sexes. There seems very little reason to doubt that several of the species will have to sink into synonymy. Thus I strongly suspect that *jacobsoni* and *bidentatus* of Szépligeti will prove to be synonymous with *metathoracica* (Ashmead), as *striatus* (Ashmead) undoubtedly is.

Key to the species of Syrites.

1. Males ..... 2.
   Females ..... 7.
2. Abdominal spines on fourth tergite ..... 3.
   Abdominal spines on third tergite ..... 4.
4. Thorax ferruginous and black ..... 5.
   Thorax usually entirely black ..... 6.
5. Mesopleura ferruginous.
   (Camptolynx) froggatti (Turner). (Australia.)
   Mesopleura black ..... **(Hemigaster) jacobsoni** (Szépligeti). (Java.)
6. Only the first tergite pale; mandibles black; propodeal spiracles rather large ..... **S. acanthogaster** Tosquinet. (Sumatra.)
   Both first and second tergites pale; mandibles pale; propodeal spiracles small.
   (Astomaspis) metathoracica (Ashmead) (=*Bathythrix striatus* Ashmead). (Philippine Islands.)
7. Thorax black ..... **(Camptolynx) ruficornis** (Turner). (Australia.)
   Thorax ferruginous or partly so ..... 8.
8. Hind tibia with a distinct pale annulus in the middle, second and third tergites each with a narrow transverse subapical furrow, which with a reversely curved basal furrow set off a distinct median area.
   S. arealis sp. nov. (Philippine Islands.)
   Hind tibia without such an annulus; transverse furrow of second and third tergites broad and shallow, basal furrows obsolete ..... 9.
9. Both front and hind wings with fuscous band.
   (Camptolynx) froggatti (Turner). (Australia.)
   Only the front wings maculate ..... 10.
10. Front wing clouded from base to basal vein.
    (Hemiteles) bidentatus (Szépligeti). (Java.)
    Front wing hyaline at base ..... 11.
11. Hind tarsus narrowly pale at base.
    (Camptolynx) striatus (Cameron). (Ceylon.)
    Hind tarus entirely black ..... 12.
12. Thorax black before, ferruginous behind; clypeus yellow; scape and pedicel black ..... **(Ischnocerus?) cancellatus** (Brullé). (Java.)
    Thorax usually entirely ferruginous, rarely with mesoscutum and pronotum blackish; clypeus at most fuscoferruginous; scape and pedicel stramineous below.
    (Astomaspis) metathoracica (Ashmead). (Philippine Islands.)

(Hemigaster) Syrites jacobsoni (Szépligeti).

Notes Leyden Mus. 29 (1908) 245, male.

This Javanese species is apparently so closely allied to *S. metathoracica* (Ashmead) that a male of the latter species compared with Szépligeti's description differs only in having the thorax and propodeum entirely black and the nervellus distinctly antefurcal.

(Hemiteles) Syrites bidentatus (Szépligeti).

Notes Leyden Mus. 29 (1908) 252, female.

This species, also from Java, is very likely the female of *S. jacobsoni* (Szépligeti). Szépligeti is the only one who has mentioned the lateral angulations on the third tergite in the female, but the analogy between these and the spines on the male escaped him.

(Ischnocerus?) Syrites cancellatus (Brullé).

Hist. Nat. Ins., Hym. 14 (1846) 262, female.

In the preceding key I have separated *S. bidentatus* (Szépligeti) from this and two other species on account of the clouded base of the wing. As a matter of fact Brullé makes no mention of this, describing the wing simply as having an incomplete brown band; and I suspect that Szépligeti has redescribed Brullé's species, especially as they are from the same island.

Syrites acanthogaster Tosquinet.

Mem. Soc. Ent. Belg. 10 (1908) 118, male.

This Sumatran species seems to be distinct from the rest in having only the first tergite red, the mandibles black, and the propodeal spiracles large and slightly oval; it may be that I am wrong in referring the other species to *Syrites,* but in all other respects Tosquinet's description accords so well with the male of *S. metathoracica* (Ashmead) that it seems impossible that they are not congeneric.

(Camptolynx) Syrites ? fuscipennis (Cameron).

Berl. ent. Zeit. 55 (1910) 253, male.

This and the following species, both from Ceylon, are the basis of Cameron's genus. Because of the stated position of the spines on the fourth tergite instead of the third they are, as stated above, doubtfully referred to *Syrites,* and Cameron's genus is doubtfully synonymized with *Syrites.*

(Camptolynx) Syrites ? quadrispinosus (Cameron).

Berl. ent. Zeit. 55 (1910) 253, male.

The status of this species is discussed under the next preceding.

(Camptolynx) Syrites striatus (Cameron).

Berl. ent. Zeit. 55 (1910) 254, female.

Regardless of whether or not *Camptolynx* is synonymous with *Syrites* there can, I think, be no doubt that this Ceylonese species is a *Syrites* although a comparison of the descriptions of this and *S. quadrispinosus* almost leads to the conviction that they are the sexes of the same species.

(Camptolynx) Syrites froggatti (Turner).

Ann. & Mag. Nat. Hist. IX 4 (1919) 41, female and male.

In having the hind as well as the front wings banded this Australian species is apparently distinct from all of the others.

(Camptolynx) Syrites ruficornis (Turner).

Ann. & Mag. Nat. Hist. IX 4 (1919) 42, female.

The entirely black thorax and propodeum, unusual in the female, renders this species very distinct. It is from Australia.

(Astomaspis) Syrites metathoracica (Ashmead).

Astomaspis metathoracica ASHMEAD, Proc. U. S. Nat. Mus. 28 (1904) 140, female.

Bathythrix striatus ASHMEAD, op. cit. 141, female.

Acanthohemiteles benjamini Ashmead manuscript, BROWN, Philip. Journ. Sci. 1 (1906) 692.

In spite of its broken nervellus and complete notauli, and in spite of the fact that the clypeus and mandibles do not agree with Foerster's description, Ashmead placed the unique type of *metathoracica* in *Astomaspis,* to which genus it was the first species referred. Because of these disagreements with the original description it cannot be the genotype of *Astomaspis.* Nor is it at all closely related to the accepted genotype, *Astomaspis nanus* (Gravenhorst), first assigned to the genus in 1910 by Roman.

On the page following the description of *metathoracica* Ashmead described another specimen, of the same species, as *Bathythrix striatus,* placing it in that genus despite its obvious disagreement with the genotype, *Bathythrix meteori* Howard, the type specimen of which was in the collection over which he

had charge. The name *metathoracica* is unfortunately chosen, for the color character on which it is based is not conspicuous and is an apparently rather rare variation, the thorax being usually entirely ferruginous.

What I take to be the male of this species is represented in the National Museum collection by four specimens, all taken at Manila, Philippine Islands, by Rev. Robert Brown. These are the *Acanthohemiteles benjamini* Ashmead manuscript, of Brown's list of Philippine Hymenoptera. There are also nine additional females taken at the same place by the same collector. Aside from the very different abdomen the male differs from the female principally in having the thorax black or largely black. In one of the four specimens examined the propodeum is piceorufous. In the female the third and fourth tergites are subangulate laterally at apex.

Syrites arealis sp. nov.

Differs from *S. metathoracica* (Ashmead) and apparently from all of the other described species in the structure of the second and third tergites, the usual transverse furrow meeting laterally the extremities of a basal reversely curved furrow, the two setting off a transverse median area.

Female.—Length, 5 millimeters; antennæ, 4. Slenderer than *S. metathoracica* (Ashmead). Head distinctly broader than thorax; temples strongly convex; vertex with striæ radiating in all directions from ocelli, a deep short groove between the lateral ocelli; frons transversely, arcuately striate; face finely, confluently punctate, elevated medially; clypeus punctate, medially irregularly striate; face, clypeus, and cheeks clothed with moderately dense white pubescence; temples and cheeks irregularly vertically striate, posterior orbits punctate; malar space nearly as long as basal width of mandible. Thorax subopaque; pronotum with the lateral furrow deep, subpolished, the dorsal portion somewhat swollen and obliquely striate; mesoscutum obscurely transversely striate, each lobe with a median opaque streak; scutellar fovea deep and foveolate but not distinctly carinately margined before and behind; scutellum reticulate punctate, margined laterally to middle; mesopleurum, metapleurum, and propodeum with long white pubescence, the pleura confluently, almost rugosely punctate; propodeum irregularly rugulose, the basal areas not defined, areola hexagonal, removed from base by its own length, lateral carina distinct only beyond apical carina, petiolar area nearly vertical, shorter than dorsal

face of propodeum, spiracles small, round; apical abscissa of radius slightly decurved; discocubitus subangulate at about its basal third; nervulus barely antefurcal; nervellus inclivous, broken below middle; hind tibia strongly compressed, as broad as femur. First four tergites striate, others polished, fifth weakly striate at base; first distinctly longer than wide at apex, spiracles just behind middle; second and third tergites each with a transverse area set off by basal and subapical curved furrows; fifth constricted near base; ovipositor less than half as long as first tergite.

Ferruginous, with head and abdomen beyond second segment black; antennæ brown, scape and pedicel testaceous; mandibles pale, the oral margins more or less red; palpi stramineous; tegulæ and humeral angles stramineous, radices of wings and base of stigma white; wings hyaline, the front wing weakly stained to basal vein, with a broad dark band across the broadest part, and a small obscure spot on the nervulus; hind wing immaculate; legs testaceous, hind femur largely piceous, tibia fuscous, with a white basal annulus and obscurely pale in the middle, tarsus fuscous; middle tibia with same color pattern obscurely developed; tergites beyond second piceous black.

Type locality.—Manila, Philippine Islands.

Type.—Catalogue No. 24057, United States National Museum. One female taken by Rev. Robert Brown.

Genus CHRYSOCRYPTUS Cameron

The species described below is apparently very closely allied to, if not the same as, the undescribed male referred by Roman [10] to this genus and on the strength of which that author synonymized Cameron's genus with *Leptocryptus* Thomson, especially the subgenus *Panargyrops* Foerster. Roman was of the opinion that Cameron mistook the costellæ for the spiracles.

The species before me differs in several respects from Cameron's description, as follows: The spiracles are round instead of linear; the ovipositor sheath is clothed with black instead of white hair; the first three joints of the flagellum are not four times as long as thick; the discocubitus is angulate and with a very short ramellus; the clypeus is distinctly tridenticulate at apex; the areola is not rounded at base; and the radius is not thickly pilose at base. From the genotype as described it differs markedly also in being entirely bright ferruginous with the legs uniformly testaceous and the wings entirely hyaline. Because of these differences I refer it very doubtfully to *Chrysocryptus*.

[10] Arkiv. Zool. 8 [15] (1913) 9.

It is certainly very closely allied to *Panargyrops*. The position of the propodeal spiracles far in front of the costellæ is very characteristic, and together with the long pubescence and general habitus indicates the close relationship. I would not, however, go so far as to place it in *Panargyrops* because of the very broad, unseparated, tridentate clypeus and the very long upper tooth of the mandible.

Chrysocryptus ? romani sp. nov.

Both generic and specific characters are given in the following description:

Female.—Length, 12 millimeters; antennæ, 7; ovipositor, 7; front wing, 10. Entire body polished and practically without sculpture, clothed with long, mostly erect, golden pubescence, this embracing also the coxæ, trochanters, and femora especially of the hind legs, and the wings especially the costa (on the wings the pubescence is blackish).

Head transverse; the temples convexly sloping; vertex broad, elevated above level of top of eyes; occipital carina strong, gradually fading out on lower cheeks; head in front view transverse; eyes very large, prominent, convergent below; malar space almost obliterated; face more than twice as broad as long, slightly impressed on each side below antennæ, its pubescence subappressed; clypeus much longer than face, very weakly separated, lateral angles and foveæ nearly touching the eyes, nearly flat with apex broadly rounded and with three distinct denticles in the middle; mandibles large, slightly tapering and with the upper tooth much longer than the lower; palpi rather short, slender, the apical two joints of maxillary palpi together but little longer than third; antennæ rather slender, slightly stouter beyond middle and tapering toward apex; apex of scape only slightly oblique; flagellar joints becoming gradually shorter from basal, which is about three times as long as thick. Thorax small, narrower than head, much smaller behind; notauli strong and terminating abruptly, without joining, shortly before the scutellar fovea; pronotum practically without pubescence, with a short foveolate groove at lower angle, epomia strong but short; prescutum sharply defined, the carina emarginate opposite the sternauli, wihch are very deep anteriorly but become obsolete posteriorly; mesopleural furrow foveolate above; metapleurum separated from sternum by a high carina, from the anterior end of which a short carina extends obliquely onto the pleurum;

scutellum convex, immargined; postscutellum long, bifoveolate at base; propodeum completely areolated, all the carinæ high and sharp; areola large, coffin-shaped, longer than petiolar area; spiracle round, situated far before the costella and nearer the lateral than the pleural carina; apex of propodeum extending distinctly over the bases of hind coxæ; wings large; stigma narrow, lanceolate; discocubitus angularly broken and with a very short ramellus, its bulla small and nearer the ramellus than the intercubitus; areolet nearly equilaterally pentagonal, the second intercubitus largely bullated; second recurrent curved outward, meeting the subdiscoideus at nearly a right angle, its bulla large and uninterrupted; nervulus interstitial; nervellus reclivous, broken at about the middle; radiella becoming obsolete shortly beyond intercubitella, cubitella entirely so; legs very slender, hind tibia about as long as thorax; front tarsus longer than, hind tarsus as long as, their tibiæ, claws and calcaria small. Abdomen subclavate; first tergite very narrow throughout, compressed, completely fused with sternite, without carinæ, spiracles distinctly before middle; second tergite about twice as long as wide at apex, nearly three times as wide at apex as at base, in lateral view concave above, with an obsolete carina running from base to spiracle; first tergite and base of second polished and with sparse erect pubescence, abdomen otherwise with dense subappressed pubescence in addition to the erect; apical tergite elongate, trowel-shaped; ovipositor slender, nearly as long as abdomen, the sheath with black pubescence.

Bright ferruginous, the face slightly paler; flagellum blackish, paler at base; legs testaceous, the tarsi slightly infuscated; wings hyaline, venation brown; ovipositor sheath black.

Male.—Like the female in almost every respect, but with the front and middle legs stramineous.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24058, United States National Museum.

Described from one female and one male received from Prof. C. F. Baker.

I take pleasure in dedicating this beautiful and interesting species to Dr. A. Roman, of Stockholm.

Genus **APOPHYSIUS** novum

This very curious genus is anomalous wherever placed. Owing to the strongly compressed abdomen it has a superficial ophionine appearance, but the form of the areolet, and the sternauli preclude its being placed in the Ophioninæ. Aside from the compression of the abdomen most of the customarily used characters ally it with the Cryptinæ. The extremely broad

areolet is unusual though not unique in the Cryptinæ, that of *Protocryptus* Schmiedeknecht being very similar. In the Cryptinæ the completely defined areolet and areolated propodeum place it in the Phygadenonini, where it seems to me less discordant than in any other placing. Here the narrow first tergite with spiracles placed in the middle is almost duplicated in *Thysiotorus* Foerster as represented by *T. lamina* (Thomson) and in *Panargyrops* Foerster. These two genera also have the bidentate clypeus and the silky pubescence of the head; while in *T. lamina* the shape of the head and the relative length of the basal flagellar joints, though slenderer, are not very different. Except that the areolet is much broader and the stigma narrower with the radius originating near its base, the venation of the present genus differs in no essential particular from that of *Panargyrops*. If couplet 3 in Ashmead's key to the Phygadenonini, the character in which can hardly be considered of generic value, be omitted, the genus runs to *Panargyrops*, though not agreeing with the last sentence. From either of these genera it is at once distinguished by the structure of the propodeum, the compressed abdomen, and the shape of the areolet.

Head from above strongly transverse with temples very narrow; from in front very broadly transverse, subtriangular; eyes large, bulging, convergent below, malar space very short; clypeus separated by elevation, bidentate at apex, mandibles bidentate, upper tooth larger and longer; scape short, subglobose, flagellum tapering at apex, first joint much longer than second; entire body, including legs, and especially the head and thorax clothed with long, silvery hairs; pronotum short, polished, with lower angle foveolate, epomia fairly strong, sharply curved; mesoscutum flattened, polished, notauli obsolete, each lateral lobe with a deep, broad, longitudinal furrow, prescutum with two parallel shallow furrows; scutellum strongly convex, not margined, basal fovea very broad and deep; postscutellum bifoveate at base; mesopleurum polished, wide in upper portion, prepectus broad below, ending above not far above ventral angle of pronotum, sternauli broad and shallow and extending about half the length of mesopleurum, subalar tubercle carinate at top; propodeum short, sloping from base, completely areolated, the intersections of the lateral carina with each of the transverse carinæ forming a prominent apophysis, the posterior one long and slender, the anterior one large and triangular in outline, embracing the entire basal abscissa of the lateral carina, and

opposed on the metapleurum by a pyramidal apophysis, each basal lateral area bearing a prominent tubercle opposed on metapostnotum by a sharp point, areola small, wider before than behind; petiolar area very narrow in front, wider behind, the apical portion of the median carinæ very high and thin, spiracles elongated oval; metasternum very short, the middle and hind coxæ very close together; legs long and slender, claws small, simple; wings large, stigma narrow with radius distinctly before middle, apex of radius far before apex of wing, areolet much broader on radius than high, intercubiti parallel, second mostly bullated, discocubitus angulated in middle, nervulus interstitial, basal abscissa of radiella and intercubitella subequal in length, nervellus reclivous, broken in middle; apical abscissæ of all longitudinal veins in hind wing obsolete except small portion of radiella; abdomen strongly compressed beyond second tergite, polished; first tergite slender, scarcely widened at apex, spiracles in middle, prominent; second tergite a little wider at base than first at apex, more than twice as long as wide, nearly parallel-sided, spiracles shortly before middle; ovipositor sheath about as long as first tergite.

Type, *Apophysius bakeri* sp. nov.

Apophysius bakeri sp. nov. Plate 1.

Female.—Length, 10.5 millimeters; antennæ, 8.5; ovipositor, 1.5; front wing, 9. Head from in front fully two-thirds broader than long; malar space nearly obliterated; clypeus slightly broader than long; face below about two-thirds as broad as vertex, latter broader than greatest diameter of eye; ocellocular line longer than width of ocellar triangle; ocelli large, diameter fully twice as long as postocellar line; face very finely, densely punctate, opaque; head otherwise polished; thorax and propodeum polished; hind tibia distinctly longer than tarsus, latter with basitarsus about half the entire length, last joint slightly shorter than third.

Black, with the following markings: Quadrate spot on middle of face, outer corners of clypeus, small marks on inner orbits reddish; scape, pedicel, prothorax except posterior margins of notum and apex of pleurum, origins of notauli, scutellum, post-scutellum, tegulæ, spot below each wing, upper portion of metapleurum behind hind wing, hind margin of mesopleurum, posterior face of propodeum, including hinder apophyses, apices of anterior apophyses, a spot astride the pleural carina, front and middle coxæ largely and apical half of hind coxa, apices of basal

trochanter joints, apices of all femora and more or less of the lower side, front and middle tibiæ above, petiole dorsally before spiracles, apices of first and second tergites broadly and of others narrowly, and second sternite white to yellowish white; legs, except as noted, piceous to black; flagellum black above, brown below; mandibles piceous; wings brownish stained, the stain deeper beyond stigma along anterior margin, venation blackish, metacarpus pale.

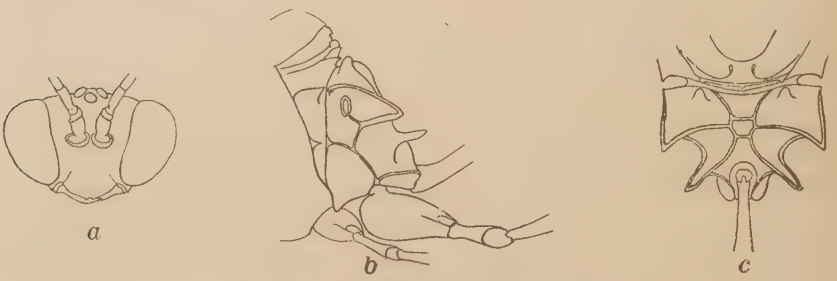

FIG. 8. *Apophysius bakeri* sp. nov.; *a*, head, front view; *b*, propodeum, lateral view; *c*, propodeum, dorsal view.

Male.—Practically identical with the female.

Type locality.—Mount Maquiling, Luzon, Philippine Islands.

Type.—Catalogue No. 24059, United States National Museum. One female and two males received from C. F. Baker.

ICHNEUMONINÆ

Ephialtes porthetriae (Viereck).

Pimpla (*Pimpla*) *porthetriae* Viereck, Proc. U. S. Nat. Mus. 40 (1911) 480.

Ephialtes formosana sp. nov.

In Morley's key to *Pimpla*[11] this new species runs to *P. appolyon* Morley, agreeing with all of the key characters and differing from the description on page 165 only in having the frons vaguely sculptured and medially canaliculate; palpi entirely flavous; tegulæ, mesothoracic spiracular sclerite, and a spot on scutellum white; propodeal spiracles very long, slitlike; all tergites narrowly white at apex; fifth tergite basally nearly as strongly punctate as fourth, others alutaceous, progressively more shining; front coxæ entirely, middle coxæ largely, and both trochanters white; stigma black, extreme base and metacarpus pale; areolet briefly petiolate, oblique.

[11] Fauna Brit. India, Hym. 3 (1913) 152.

It is also closely related to the Japanese *Ephialtes porthetriae* (Viereck), but that species, described only in the male, has the hind legs entirely (except extreme base of femur and apex of trochanter) and the front and middle coxæ and trochanters black, and differs also in structure and sculpture.

Female.—Length, 19 millimeters; antennæ, 15; ovipositor, 4.5. Temples very strongly receding; frons deeply concave, medially canaliculate, obsoletely punctate; face broader at clypeal foveæ than at antennæ, densely punctate, obliquely striately so above, less densely so at sides, with a median polished ridge, swollen above clypeal foveæ; clypeus coarsely punctate at base, polished and impressed in its apical two-thirds, apex subtruncate, the margin foveolate; malar space slightly more than half as long as basal width of mandible; eyes broadly emarginate opposite frons; ocelli large, diameter of a lateral ocellus nearly twice as long as ocellocular line and distinctly longer than postocellar line; antennæ slender filiform, first flagellar joint eight or more times as long as thick and a half longer than second; mesoscutum subpolished, obsoletely punctate, notauli practically wanting; scutellum flattened above, ridged laterally, polished; mesopleurum coarsely, subobsoletely punctate; metapleurum obliquely striate; propodeum transversely irregularly striate, polished behind, strongly ridged laterally, without carinæ, spiracle slit-like; abdomen very densely opaquely punctate; alutaceous at apex, each tergite with a narrow polished margin; first tergite without dorsal carinæ but with two low rounded elevations at summit; tergites 2 to 4 with decreasingly distinct subapical impressions and lateral elevations.

Black, with palpi, tegulæ, spiracular sclerite, spot on scutellum, front coxæ, middle coxæ at apex, and their trochanters whitish; front and middle legs otherwise stramineous, except base of middle coxa which is black; hind legs black with a broad whitish annulus on tibia; wings yellowish hyaline; abdomen with apices of tergites pale.

Host.—*Metanastria punctata* Walker.

Type locality.—Formosa.

Type.—Catalogue No. 24060, United States National Museum. One female reared from the host pupa by T. Shiraki.

Genus LEPTOBATOPSIS Ashmead

Because of the unretracted hypopygium Ashmead described this genus in the Acoentini. The genotype, *Leptobatopsis australiensis* Ashmead, is from Australia. Ashmead subsequently

redescribed it from the Philippine Islands, referring it to the lissonotine genus *Atropha* Kriechbaumer and calling it *Atropha clypearia*. *Atropha* is unknown to me except by description, but it is very closely allied to *Leptobatopsis* and possibly should include the latter genus as a synonym.

In 1913 [12] and again in 1915 [13] Morley referred several Indian species to *Syzeuctus* Foerster. One of these is *Cryptus indicus* Cameron, with which Morley synonymized *Mesoleptus annulipes* Cameron and *Tanera annulipes* Cameron. With Cameron's three descriptions *Leptobatopsis australiensis* agrees very closely, except with the sculpture of the thorax and the maculation of the mesoscutum in *Tanera annulipes*. Morley's synonymizing of the latter species with *C. indicus*, however, indicates that these differences do not exist, and I would certainly synonymize *L. australiensis* with *C. indicus* Cameron were it not for the fact that Morley states that the spiracle of the first tergite is slightly before the middle, while in *L. australiensis* it is distinctly though slightly behind the middle. Moreover, the first tergite is distinctly petiolate, which is not true of any of the species of *Syzeuctus* known to me. It may be that species intermediate in this character occur in the Indian fauna, but for the present it seems wise to retain Ashmead's name. The petiolate abdomen gives this species an appearance strongly resembling the Campoplegini, to which tribe I believe the Lissonotini are much more closely related than to the Ichneumonini (Pimplini).

Leptobatopsis australiensis Ashmead.

Leptobatopsis australiensis ASHMEAD, Proc. U. S. Nat. Mus. 23 (1900) 47; Proc. Linn. Soc. N. S. Wales, pt. 3 (1900) 349.
Atropha clypearia ASHMEAD, Proc. U. S. Nat. Mus. 28 (1904) 143.

Additional specimens from Singapore of this widely distributed species indicate that it probably occurs throughout the Oriental and Australian Regions. The principal variation aside from size is in the presence or absence of certain of the white spots on the head and thorax. The spots on the sides of the face, the one in the malar space, and those on the humeral angle of the pronotum and tegula are sometimes wanting, while the extent of white on the abdomen is variable, that on the apical tergites being sometimes absent.

Unless *Syzeuctus indicus* (Cameron) is the male of this species, that sex has not been described. It differs from the female

[12] Fauna Brit. India, Hym. 3 (1913) 234–240.
[13] Ann. & Mag. Nat. Hist. VIII 16 (1915) 337.

principally in having the clypeus entirely and the face largely white, the flagellum pale ferruginous beneath, and the fourth tergite, as well as the first to third, white at base and apex.

OPHIONINÆ

Zacharops narangae sp. nov.

The only way in which *Zacharops* as described by Viereck differs from *Charops* is in its lack of the mesosternal processes between the hind coxæ. The genotype also differs from that of *Charops* in having the scutellum concave between the lateral carinæ, the head thinner and more nearly lenticular, and the eyes more sharply emarginate. In all of these characters the present new species agrees with *Zacharops;* while it agrees better with *Charops* in the lack of complete propodeal areas and mesopleural impression and the form of the abdomen, especially of the first tergite, which is less slender with the postpetiole more bulbous than in *Zacharops annulipes* (Ashmead).

Female.—Length, 9 millimeters; antennæ, 6; front wing, 5. Head set very close to thorax, strongly lenticular, vertex and temples very strongly receding, opaque-punctate and, with the thorax, densely silvery pilose; face slightly narrower below than at antennæ; malar space half as long as basal width of mandible; ocellocular line more than half as long as diameter of lateral ocellus; thorax in both dorsal and lateral views short-ovoid, the propodeum very precipitous from base; pronotum rugose; mesoscutum very densely punctate, more coarsely so in the positions of the absent notauli; scutellum opaque-punctate, very densely pilose, slightly concave; mesopleurum reticulate-rugose, convex throughout, without impression; metapleurum divided longitudinally by an auxiliary carina, below which it is reticulate-punctate and above which it is transversely rugose; propodeum laterally transversely rugose, medially reticulate, the lateral and basal carinæ obsolete, others absent; abdomen slender; first tergite curved upward, postpetiole strongly bulbous, more than half as long as the slender petiole, without carinæ; second tergite slightly compressed for its entire length and with a small impression on each side at about the middle (this is common to the genotypes of both *Charops* and *Zacharops*); the spiracles slightly before apical fourth; tergites 3 to 5 subequal, little more than half as long as second, each deeper than the one preceding, sixth shorter and deeper than fifth, others very small; ovipositor barely exserted; entire abdomen beyond first tergite densely clothed with short, appressed pubescence.

Head and thorax black, abdomen largely ferruginous; scape and pedicel below, mandibles, palpi, front and middle legs, hind trochanters, tegulæ, and wing bases whitish; flagellum fuscous, more reddish toward tip; hind coxæ black basally, reddish at apex; hind femur testaceous, tibia stramineous with subbasal and apical infuscation, tarsus fuscous, calcaria white; wings hyaline, venation brown; petiole stramineous; second tergite medially and narrowly at apex blackish; a narrow line near lateral margins of second and third tergites also black.

Male.—Like female in size, sculpture, and structure, and differing practically only in having the abdomen black at apex.

Host.—*Naranga aenescens* Moore.

Type locality.—Formosa.

Type.—Catalogue No. 24061, United States National Museum.

A female and a male reared from the host larva by T. Shiraki. The cocoon from which the male emerged is on the pin. It is 6 by 2.5 millimeters, cylindric-ovate with a suspension thread at the caudal end. It is dirty white with the caudal end and a row of spots near each end black.

Hyposoter flavus sp. nov.

In spite of the indistinctly areolated propodeum and the very small, occasionally absent areolet, there is apparently no real reason for erecting a new genus for this species. In fact, the most striking difference to be noted is the nearly uniform pale yellow color of the head and thorax.

Female.—Length, 10 millimeters; antennæ, 7. Head from above very thin, the temples nearly flat and sharply sloping; face densely punctate, nearly flat; frons coriaceous, with a median carina from anterior ocellus to between antennal foramina; eyes large, concavely curved within; ocellocular line about half as long as diameter of a posterior ocellus, postocellar line slightly longer; malar space hardly half as long as basal width of mandible; thorax largely closely punctate; pronotum striate laterally; upper hind portion of mesopleurum polished, with a few short striæ in front of the polished area; mesopleural furrow foveolate; notauli weakly and broadly impressed anteriorly; scutellum strongly convex, sloping to apex; propodeum medially impressed, the carinæ usually distinct in the genus more or less indicated, especially the basal transverse and the apical abscissa of the lateral and pleural carinæ; spiracle elongate-oval, small; legs slender, longer hind calcarium reaching more than three-fourths of the way to apex of basitarsus; areolet very small with a very

long pedicel; nervulus postfurcal by nearly half its length; discocubitus curved, without a ramellus; nervellus nearly straight, unbroken, perpendicular; abdomen rather strongly compressed; spiracles of first tergite at apical third; ovipositor exserted about half the length of first tergite.

Flavous; a spot on vertex running down onto occiput and embracing ocelli, median, lateral, and posterior spots on mesoscutum, and a small spot on each side of propodeum at base blackish; flagellum blackish; legs flavous, hind tarsus and tibia at apices and articulation between hind femur and tibia blackish; wings hyaline; abdomen darker than thorax, especially toward apex.

Male.—Differs from female principally in having the malar space distinctly more than half as long as basal width of mandible and blackish spots on outside of hind coxa and trochanter.

Type locality.—Mount Limay, Luzon, Philippine Islands.

Other locality.—Manila, Philippine Islands.

Type.—Catalogue No. 24062, United States National Museum.

Two females and one male from the type locality collected by C. F. Baker, and one female from Manila collected by the Rev. Robert Brown. The Manila specimen lacks the black spots on the propodeum and the areolet in one wing, and is somewhat smaller.

ILLUSTRATIONS

PLATE 1

Apophysius bakeri sp. nov.; male. From a photograph by Herbert S. Barber.

TEXT FIGURES

FIG. 1. *Ctenocharidea luzonensis* sp. nov.; *a*, thorax and base of abdomen, lateral view; *b*, portion of thorax, propodeum, and base of abdomen, dorsal view; *c*, wings; *d*, claw of hind tarsus.

2. *Pycnopyge bella* sp. nov., female; *a*, entire insect; *b*, head, front view; *c*, thorax, lateral view; *d*, first abdominal segment, lateral view; *e*, apex of abdomen, lateral view.

3. *Nesostenodontus bakeri* sp. nov., female; *a*, dorsal view; *b*, head, lateral view; *c*, clypeus and mandibles; *d*, first tergite, lateral view.

4. *Idiognathus balteatus* sp. nov.; *a*, head, dorsal view; *b*, head, lateral view; *c*, clypeus and mandibles; *d*, propodeum; *e*, first abdominal segment, lateral view; *f*, first abdominal segment, dorsal view; *g*, second tergite, dorsal view.

5. *Elasmognathias albitarsis* sp. nov., head; *a*, ventrocephalic view; *b*, lateral view.

6. *Earrana malayensis* sp. nov.; *a*, dorsal view; *b*, head, front view; *c*, thorax, anterior portion, lateral view to show prescutum, *pscl*, and epomia, *ep*.

7. *Esuchonematopodius luzonensis* sp. nov.; *a*, head, front view; *b*, venation in areolar region; *rad*, radius; *cub*, cubitus; *rec*, recurrent; *c*, thorax, lateral view.

8. *Apophysius bakeri* sp. nov.; *a*, head, front view; *b*, propodeum, lateral view; *c*, propodeum, dorsal view.

PLATE 1. APOPHYSIUS BAKERI SP. NOV., MALE.